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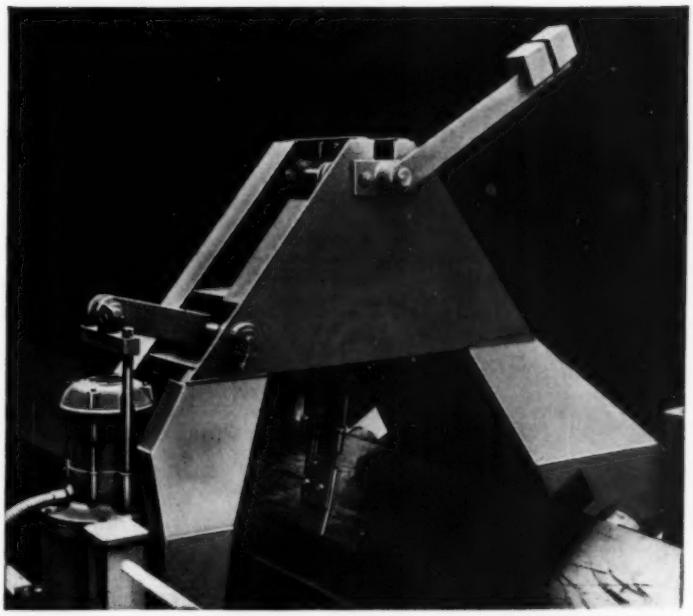

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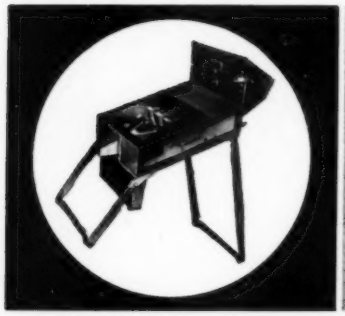

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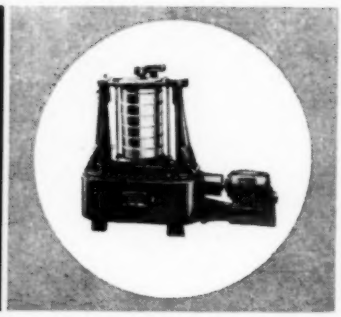

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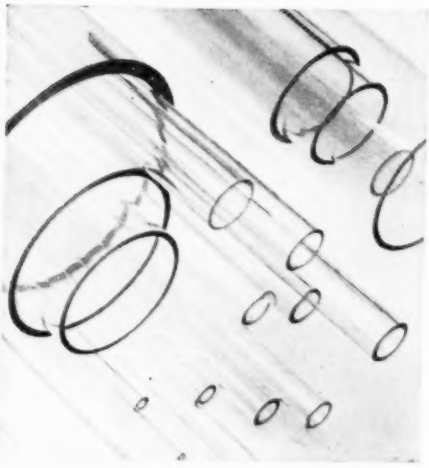

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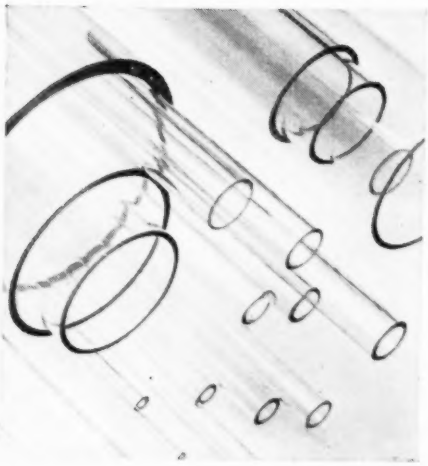

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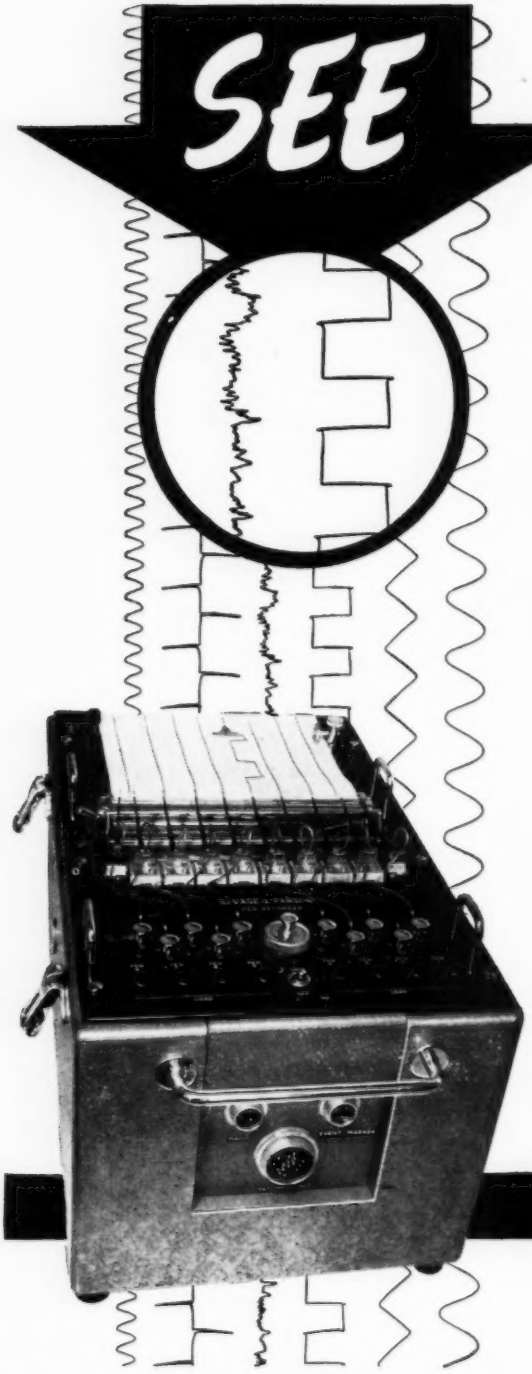

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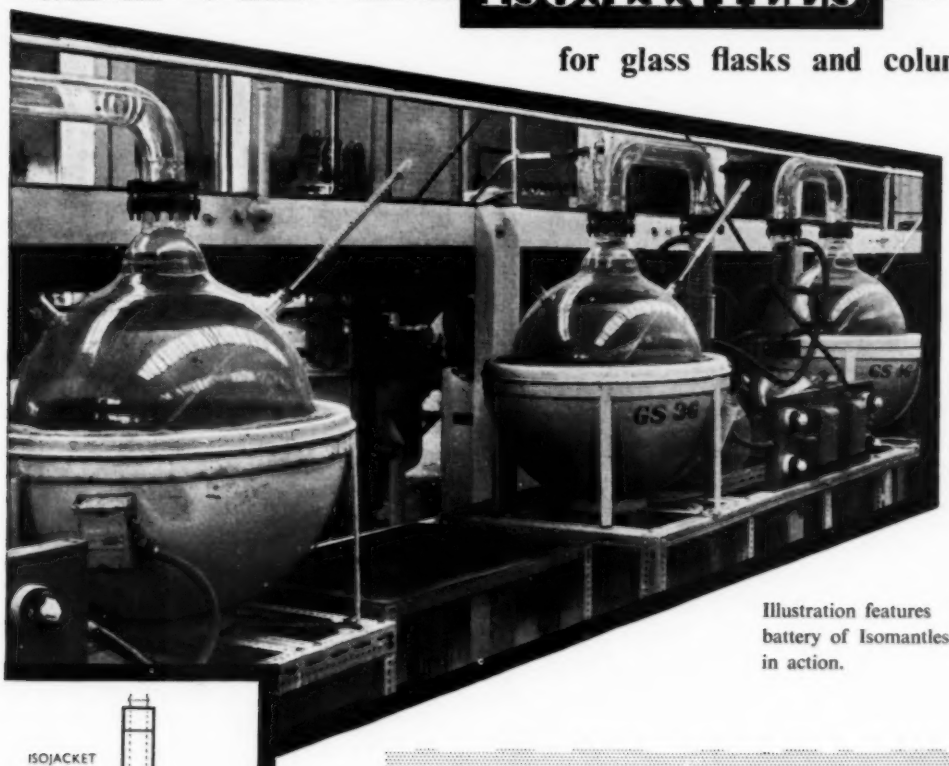
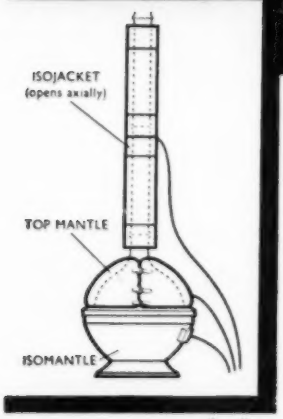


Illustration features battery of Isomantles in action.



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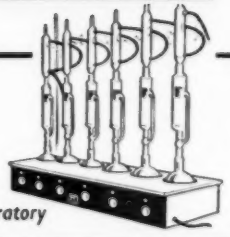

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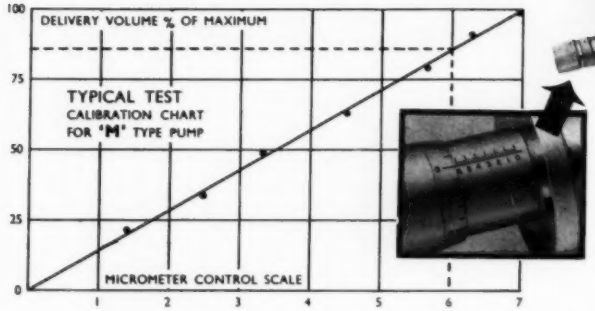

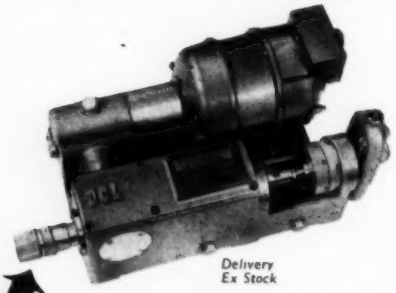

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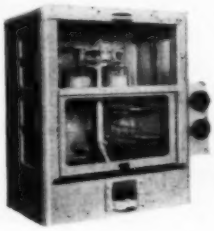

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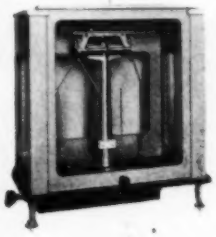

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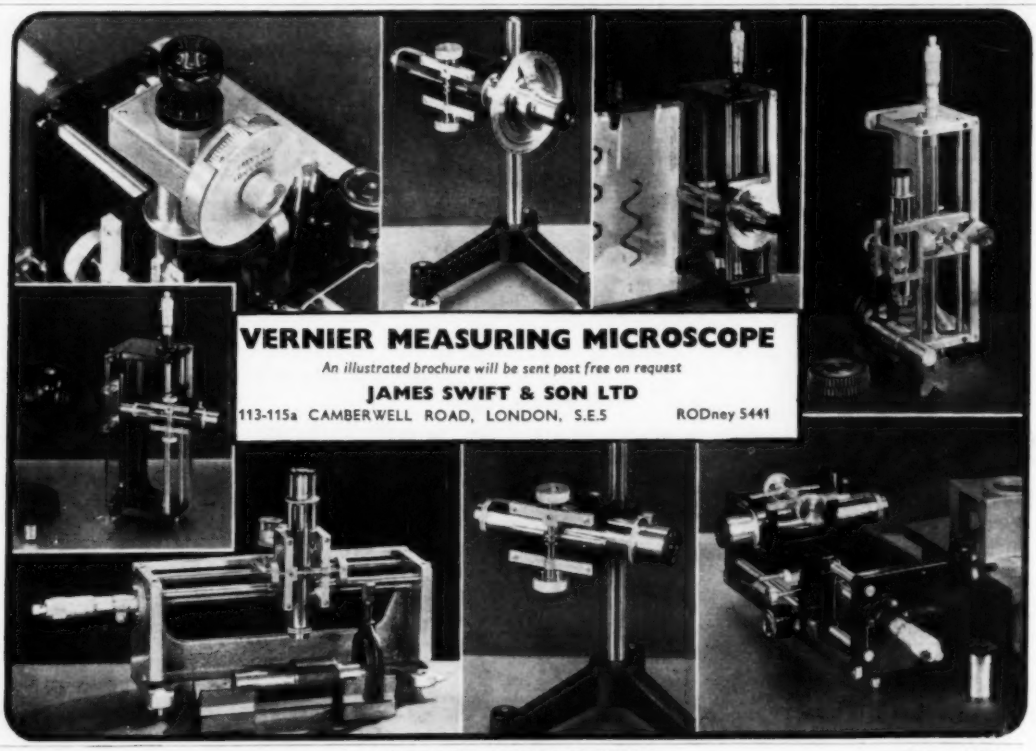

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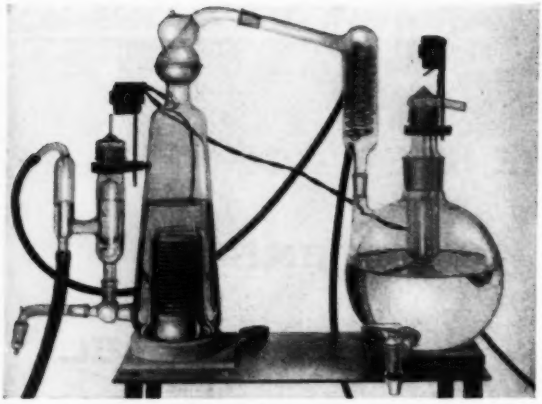

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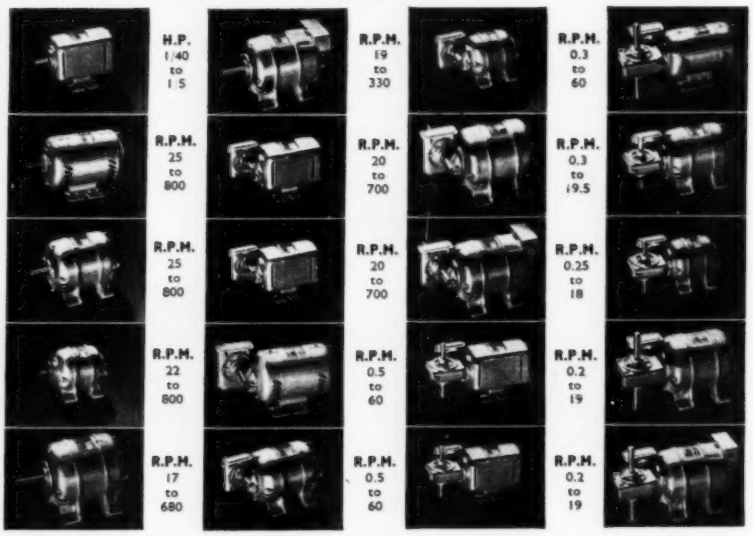

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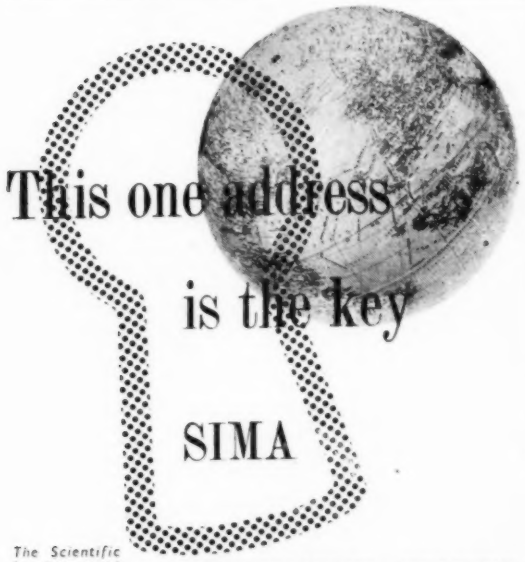

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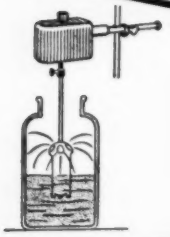

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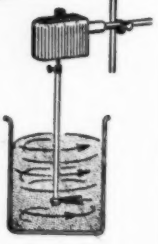

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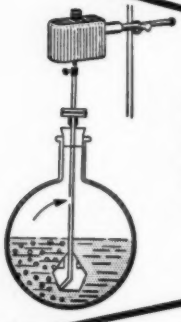

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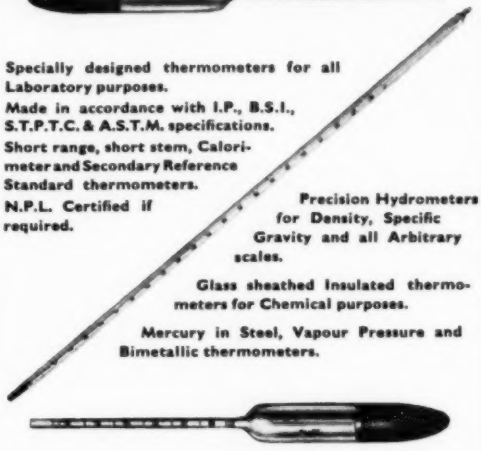

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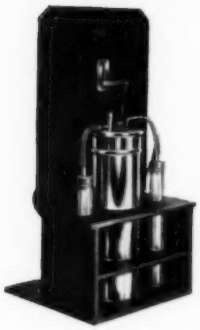

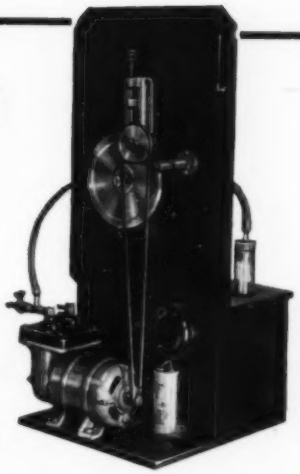

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Vol. 8 JUNE 1959 No. 6

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EDITORIAL

Research and Technique

WHEN Marjory Stephenson, who more than any other can be regarded as the founder of microbiological chemistry as a discipline in this country, died the Society for General Microbiology decided to honour her memory by founding a lecture to be given from time to time by a distinguished microbiologist. The fourth Memorial Lecture was given recently by Dr. G. S. Wilson, Director of the Public Health Laboratory Service and distinguished for his contributions to public health bacteriology. Dr. Wilson chose for his title 'Faults and Fallacies in Microbiology' and discussed the part played by faulty technique in reaching erroneous conclusions.

Readers of this journal will not need to be reminded that all experimental sciences are founded upon experiments and all experiments are really technique. Without them there would be no physics, chemistry, botany, zoology or microbiology. There is sometimes a tendency to look down on the analyst, both in chemistry and other sciences, but where would chemistry be without accurate analysis? The skilled experimenter without an original mind may never produce a major advance, but the original mind which is not combined with a good technique can easily produce a major reverse.

Dr. Wilson drew attention to a point of particular interest to young research workers, namely how a publication by a distinguished and well-known scientist can perpetuate an error. As an example he quoted various erroneous beliefs on the behaviour of the tubercle bacillus, a subject which has always been a popular field for the medical bacteriologist, and especially the learners. Bacteriology is a subject in which it is extraordinarily easy to fall down on technique. The purity of the culture, dependance on such methods as the Berkefeld candle to free liquids from ordinary micro-organisms, the snares in staining material obtained from animal tissues, the possible pre-existence of the specific bacterium in the experimental animals, the variability of the individual animals, the various ways in which one disease may manifest itself, the possibility of bacterial cells being retained on slides from a previous experiment, ease of contamination and variations in media

and culture conditions are only some of the causes of failures in technique.

During the first quarter of the century there were a number of major 'discoveries' in bacteriology which were later proved to be fallacies. One of the most famous was the alleged filterable stage of the tubercle bacillus, and another the claim that tuberculous bacillaemia was common and could afford a method for diagnosis of the disease. Perhaps the most famous was the group of claims for the culture of filterable organisms by the ascitic fluid kidney culture technique. Some of the world's most famous bacteriologists fell down in this way. Claims were made for the successful isolation and culture of the filterable cells causing, or associated with rabies, poliomyelitis, the common cold, influenza, trench fever, acute nephritis, measles, rubella, mumps, typhus fever and encephalitis lethargica. This imposing collection of discoveries was unhappily shown to be worthless by Arkwright in 1919. The alleged filterable particles were shown to be bits of protein resulting from autolysis of the kidney, and the bacteriological phenomena to be caused by contaminating staphylococci and diphtheroids. Even the simplest, and when you know the answer the most obvious, sources of error were overlooked. Thus it was shown that under the experimental conditions employed 20 per cent of the tubes became contaminated.

Research workers may be born rather than made, but much can be done to teach workers the necessity of having controls for *all* variables affecting their experiments. Admittedly the early workers were handicapped by lack of bench space, experimental animals and money, but there are rarely such excuses today.

Dr. Wilson also drew attention to the salutary effect of criticism by one's colleagues, a feature that is not available to isolated workers. Regular discussion, healthy criticism and an elementary knowledge of statistics are some of the best friends of the young research worker. Finally we may advise him never to take anything as infallible, even when issuing from the lips of his professor. 'Politeness with scepticism' should be his motto.

The Royal Society hold Conversazione

On May 14, the Royal Society held a Conversazione in the Rooms of the Geological Society during the course of which guests were able to see some 29 exhibits and a film 'Radio Astronomy in Australia'.

Among the exhibits were:

1. Plant and animal remains from the interglacial deposits beneath Trafalgar Square. Dr. J. W. Franks, University Museum, Manchester, Mr. M. P. Kerney, Imperial College of Science and Technology, London, and Dr. A. J. Sutcliffe, British Museum (Natural History).

2. Growing animal cells and tissues in test-tubes for use in biological research. Dr. J. Paul, Department of Biochemistry, University of Glasgow.

3. Dislocations in crystals. Associated Electrical Industries Research Laboratory, Aldermaston; H. H. Wills Physics Laboratory, University of Bristol; Crystallography Laboratory, Cavendish Laboratory and Department of Metallurgy, University of Cambridge; Metallurgy Division, National Physical Laboratory, Teddington: Tube Investments Research Laboratory, Cambridge.

4. Immunization against poliomyelitis (the exhibit showed how the degree of immunity produced as a result of inoculation with poliomyelitis vaccine can be measured and illustrated the level of this immunity in people of different ages). Dr. D. G. Evans and Dr. F. T. Perkins, National Institute for Medical Research, London.

5. The incorporation of H^3-thymidine in the nuclei of meristematic and elongating cells of roots: demonstrating some aspects of reproduction of chromosomes and metabolic activity of DNA in non-dividing newly differentiated nuclei. Mr. L. F. La Cour and Dr. S. R. Pelc, John Innes Horticultural Institution, and the Medical Research Council, Biophysics Unit, King's College, London.

6. Nerve impulses in single sensory nerve fibres in the skin of rays following mechanical stimulation, recorded with an electrode placed on the outside of the skin. Dr. R. W. Murray, Department of Zoology and Comparative Physiology, University of Birmingham.

7. Colour projection of electron microscope pictures showing a virus treated so as to locate the nucleic acid that causes it to be infectious. Dr. S. Brenner, Mr. R. W. Horne and Mrs. L. Barnett, Medical Research Unit for Molecular Biology and Electron Microscope Group, Cavendish Laboratory, Cambridge; and Dr. R. C. Valentine, National Institute for Medical Research, London.

8. New types of solid conductors of electricity based on graphite and on its crystal compounds with potassium and bromine. Prof. A. R. Ubbelohde, F.R.S., Department of Chemical Engineering, Imperial College of Science and Technology, London.

9. The X-ray fluorescent spectrometer employing radioisotope sources. Dr. G. B. Cook, Dr. C. E. Mellish and Mr. J. A. Payne, Isotope Research Division, Atomic Energy Research Establishment, Harwell.

10. Apparatus for rapid paper chromatographic analysis accelerated by centrifugal force. Dr. J. R. Tata and Mr. A. W. Hemmings, National Institute for Medical Research, London.

11. Hybrids among mimetic and non-mimetic species of North American *Limenitis* butterflies. Dr. C. L. Remington, Genetics Laboratory, The Museum, Oxford.

12. A laboratory method for simulating the severe damage experienced by aircraft and missiles moving at very high speeds through rain was exhibited. A cine film showed in detail the manner in which a small mass of water colliding with a solid surface at 2,000 m.p.h. breaks up the solid. Examples were also given of this type of damage in a large number of materials. Dr. F. P. Bowden, C.B.E., F.R.S. and Mr. J. H. Brunton, Research Laboratory for the Physics, and Chemistry of Solids, Cavendish Laboratory, Cambridge.

13. The problem of controlling cabbage rootfly: a serious pest of plants of the cabbage family. Insecticides should be used carefully against this pest because other insects which normally keep its numbers down are more easily killed and the effect of the chemical may be the opposite of that intended. Dr. R. D. Hughes and Mr. D. W. Wright, Entomology Section, National Vegetable Research Station, Wellesbourne.

14. Counting electrons extracted from metal surfaces for assessing the suitability of the surfaces for use in various electrical discharge devices. Dr. E. Jones, Prof. F. Llewellyn Jones and Mr. D. J. Nicholas, Department of Physics, University College of Swansea, University of Wales.

15. An illusion of movement in stroboscopic light. Dr. D. M. MacKay, Department of Physics, King's College, London.

16. An apparatus for studying the enzymic digestion of a single layer of radioactive fat molecules on a water surface. Dr. A. D. Bangham and Dr. R. M. C. Dawson, A.R.C. Institute of Animal Physiology, Babraham, Cambridge.

COLORIMETRIC MICROCHEMISTRY IN THIN FILM RESEARCH

by O. S. Heavens, B.Sc., Ph.D., F.Inst.P.

Microchemical techniques are described which are suitable for handling films formed by thermal evaporation. Precautions in the colorimetric methods used enable the masses of films of e.g. Ni or Fe of thickness ≈ 100 Å to be determined to within better than ± 0.5 per cent.

Introduction

Colorimetric methods suitable for the determination of concentrations of many ions of the order 1 microgram (γ) per millilitre have been extensively developed (Feigl, 1954, Johnson, 1955). They are generally used over the range of concentrations for which Beer's law (density of colour linearly proportional to concentration) applies—a range which for many colorimetric reagents may extend only up to a few γ per ml. If the quantity of material present is such that test solutions of the order of tens of ml. can be made, then absorption cells several centimetres long can be used and accuracies of estimation of ≈ 0·2—0·5 per cent are attainable with various commercial instruments.

These methods of estimation are of particular use for work on films formed by thermal evaporation (Heavens, 1952, Holland, 1958). Experiments on such films frequently need only a square centimetre or so of film. Films of this area can be produced easily with adequate uniformity. Considerable complexity is entailed if uniformity is required over very large areas, particularly when the materials can be evaporated only slowly. Under these conditions, the total mass of material available for the mass determination may amount to only a few micrograms. As the colorimetric reaction may necessitate mixing several reagents, it is clear that the total volumes of solutions used must be kept small, if the final concentration is to be in the desired range. To take a specific example, consider the estimation of nickel in a film of area 1 cm.² and thickness 100 Å, of which the mass is ≈ 9 γ. In the estimation of nickel using nioxime (Johnson and Simmonds, 1946), the volume of test solution is increased approximately three-fold when the various reagents have been added. It proves difficult to dissolve such films in less than ≈ 1 ml. of reagent. If the acidity of the test solution is not known it is convenient to have a trial run in which the conditions for getting the pH approximately correct are found. Thus if a final concentration of ≈ 3 γ ml⁻¹ is aimed at—which with nioxime produces a colour density within the Beer's law range and which is reasonably accurately measureable—then the volumes of reagents which need to be dispensed and accurately measured are of the order 0·1 to 1 ml.

The purpose of this article is to consider the accuracy which can be expected in measurements of this kind without inordinate complexity of apparatus.

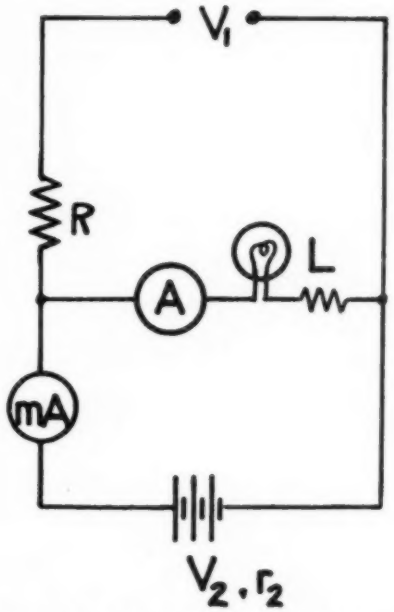

Fig. 1. Simple circuit for stabilizing colorimeter lamp current.

Light Intensity Measurements

Unless the coloured complex which is produced in the reaction possesses a very narrow absorption band, a filament lamp combined with a dye filter provides a suitable source. For use with materials with sharp absorption bands, interference filters (which are now commercially available with bandwidths as low as a few angstroms and with a peak transmission of > 70 per cent) may be used. Some form of lamp current stabilization is necessary, but as readings are to be taken alternately on reference and test cells, long term stability is not necessary. The well-known arrangement of Fig. 1 has been found to be adequate. The variation Δi_L in current i_L for a change ΔV_1 in the mains supply is given by:

$$\Delta i_L \approx \frac{r_2 \Delta V_1}{RL}, \quad \ldots \quad \ldots \quad (1)$$

where r_2 is the internal resistance of the reference cell,

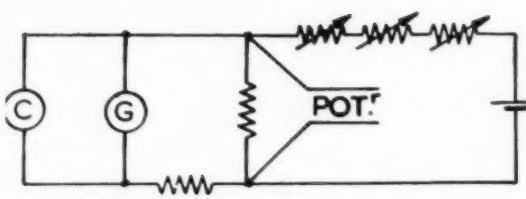

Fig. 2. Zero-impedance circuit for barrier-layer photocell measurements.

With $V_1 \approx 200$ volts, $V_2 \approx 6$ volts, $i_L \approx 0{\cdot}5$ amp. and taking the internal resistance of the reference battery supply as $\approx 0{\cdot}01\ \Omega$, we see that a 1 per cent change in V_1 produces only $\approx 0{\cdot}001$ per cent change in i_L.

In view of the fact that, to avoid stray light, the lamp is generally run in an enclosed housing, it is desirable to underrun the lamp by $\approx$ 10 per cent. With this arrangement, a short-term stability of better than 1 in 10^4 is achieved.

Light intensity measurements are conveniently made using a selenium barrier-layer photocell. The zero-impedance circuit shown in Fig. 2 is used, the potential difference across S at balance being measured to five figures on a Tinsley potentiometer. In order to detect a change in photocell output of $\approx$ 1 in 10^4, the galvanometer G should have a sensitivity of $\approx$ 1200 mm. μA^{-1}. As the internal resistance of the barrier layer cell is high, a high-resistance galvanometer can be used. It is advisable to mount all components of the circuit on rubber or wax: it may be necessary to perch the operator's stool on wax blocks in order that light intensity rather than relative humidity measurements result. Although it has not proved necessary to use a temperature-controlled room, the apparatus must be kept clear of draughts.

The overall stability of the lamp and measuring circuit is indicated by the results in Table I, taken over a period of about five minutes. Each cell contained blank solutions.

TABLE I

$V_{OL}(\mu V)$	$V_{OR}(\mu V)$
15310	14749
15314	14755
15313	14750
15320	14742
15315	14740
Mean: 15314.4 ± 1.7:	14747.2 ± 2.7

The means are thus reliable to within better than one part in 5,000.

Solution Volume Measurements

Before an estimate of the accuracy of the mass determinations can be made, it is necessary to consider the accuracy attainable in delivering and handling solutions in quantities of the order 0·5 ml. The 'Agla' micrometer syringe enables quantities of 0·5 ml. to be delivered with an accuracy of 1 in 1,000. The problem of combating evaporation loss is generally dealt with by delivering solutions into a mercury-filled U-tube closed on one limb. This procedure is not easy for small volumes. The following methods have proved satisfactory.

The first problem encountered in studies of evaporated films is that of dissolving the film in an accurately known volume of reagent and ensuring that no evaporation loss occurs. The vessel needs to be large enough to take the film on its substrate, e.g. a glass slide $\approx$ 1 cm. square. A microcell, or other suitable vessel with a flat ground top is used, the top being sealed with a glass plate (Fig. 3), lightly greased at the edges. A small hole in the plate allows the end of the micrometer syringe needle to be inserted. Evaporation is thus restricted to the gap between the needle and the walls of the hole. As the conical part of the needle practically closes the hole, evaporation loss is negligible. As soon as the needle is withdrawn the hole is sealed with a small piece of greased coverslip. When the solution is required for measurement, the needle of an empty syringe is inserted and solution drawn up for subsequent discharge. The reagents for the colorimetric reaction are conveniently delivered into vessels such as that sketched in Fig. 4. The constriction in the tube is such that it can be closed by the conical part of the Luer needle of the syringe. The glass ball is pushed aside as the vessel is brought up to the syringe and falls back as the tube is withdrawn, sealing the tube. With a well-fitting ball, the rate of evaporation with the ball in place is found to be $<$ 10 micrograms per minute. (Except when the tube

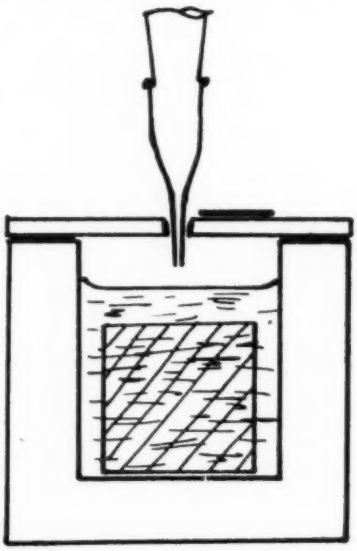

Fig. 3. Filling vessel for dissolving the film.

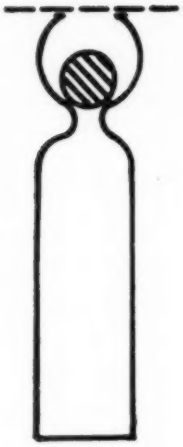

Fig. 4. Vessel for mixing colorimetric reagents.

is being filled, the ground top is closed with a greased coverslip.) Thus with ≈ 1 ml. liquid present, the loss by evaporation during the few minutes required for mixing solutions and transferring to the absorption cells is less than 1 part in 10^4. As it is not necessary to know the volume of solution in the absorption cell (the transmission/concentration relation being determined by calibration) the solution is transferred from the tube (Fig. 4) by an uncalibrated syringe.

In dealing with the 100 Å nickel film mentioned above, the film is dissolved in 1·5 ml. dilute HNO_3 and two test solutions are made up as follows:

0·7 ml. Ni solution
0·4 ml. 5N HCl
0·1 ml. gum arabic (10 per cent)
0·4 ml. nioxime (cyclohexane-1:2-dione dioxime)
0·4 ml. 5N ammonia.

It can be seen that, with the quantities given above, the total volume of the test solution may be determined to within ± 0·25 per cent.

For calibration purposes, standard solutions containing ≈ 0·02—0·05 g.l.$^{-1}$ are convenient. Made from spectrographically pure materials, their concentration can be determined to better than 1 in 10^4 with ease. Solutions of this concentration are conveniently made in two stages—0·5 g.l.$^{-1}$ followed by ten-fold dilution.

For preparing the coloured solutions for calibration, an accuracy of 1 in 1,000 is readily attained if suitably large volumes are employed.

Calibration of the Colorimeter

Standard microcells are used, fixed in position in front of the photocell. A shutter enables light to pass through either cell. The cells are sealed with a greased coverslip; no evaporation loss is detectable over a period of many hours with this arrangement.

The procedure adopted is to use one cell as a monitor of the overall response of the lamp and detector system and to use the other for measuring test solutions. Initially blank solution is placed in both cells and the potentiometer readings, V_{OL} and V_{OR} are taken. Test solutions are placed in the right hand cell and readings are taken on both cells—V_L and V_R. Any change in the overall sensitivity is indicated by any difference between V_L and V_{OL}. The corrected reading of the test cell is given by $V = V_R \times \frac{V_{OL}}{V_L}$ and the density of the solution is $\log_{10}\left(\frac{V_{OR}}{V}\right)$

Over the range for which Beer's law is valid:

$$\log_{10}\left(\frac{V_{OR}}{V}\right) = kC$$

so that k may be determined. Values obtained in a calibration for iron using Tiron (Reynolds, 1956) are given in Table II.

TABLE II

Conc. (γ/ml.)	$\frac{V_{OR}}{V}$	k
2·455 ± 0·001	$1{\cdot}387_2 \pm 0{\cdot}0004$	0·0592 ± 0·0002
1·650 ± 0·001	$1{\cdot}253_9 \pm 0{\cdot}0004$	$0{\cdot}0595_5 \pm 0{\cdot}0003$
0·832 ± 0·001	$1{\cdot}119_8 \pm 0{\cdot}0005$	0·0591 ± 0·0006

The weighted mean of the calibration constant k, from these figures, is k = 0·0593, with an uncertainty of one or two in the last figure. If a larger number of calibration solutions are used, the best value of K would be obtained by the method of least squares. In view of the limited accuracy attainable in making up test solutions from samples of the order of micrograms in weight, the accuracy of the above k-value is adequate.

Conclusions

With the precautions outlined above, microchemical estimation of the mass of nickel and iron of the order10 micrograms may be made within an uncertainty of less than ± 0·5 per cent. The procedures given are suitable for any colorimetric reactions; for reagents with a sensitivity comparable with those for nickel and iron, the same order of accuracy should be attained. It is likely that the accuracy attained represents the limit for what is an essentially simple set-up. It is unlikely that much higher accuracy can be attained without, e.g. a room maintained at constant temperature and humidity.

ACKNOWLEDGMENTS.—*Thanks are due to Mrs. M. Brown, to G. L. Moss and to A. Grant for assistance with the measurements quoted.*

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FUSED SILICA AND FUSED QUARTZ

by J. A. Frost

Chemistry Department, University of Reading

PART III

Fibres

An extremely useful property of clear fused silica is that it may be readily drawn into fibres, and at these small diameters it is remarkably strong, only tungsten surpassing it in strength. This property was discovered by Boys as long ago as 1887, and the method he evolved for producing long straight fibres is still used. There are five main methods of producing fibres:

1. Boys' method, which consists of firing a crossbow whose arrow has a piece of molten fused silica attached between it and the stock of the bow.
2. Another method described by Boys is one in which a fused silica rod is melted and pulled rapidly apart in the flame so that fibres are projected forwards and upwards and caught on a nail studded board.
3. The method described by Neher, in which a vertical flame is used to pull fibres upwards.
4. Allowing a weight loaded rod of softened silica to fall a controlled distance.
5. Drawing a continuous filament from a melting rod on to a rotating drum. By using this method fibres of varying length may be produced with diameters ranging from 0·001 mm. (1 μ) to 0·1 mm. (100 μ).

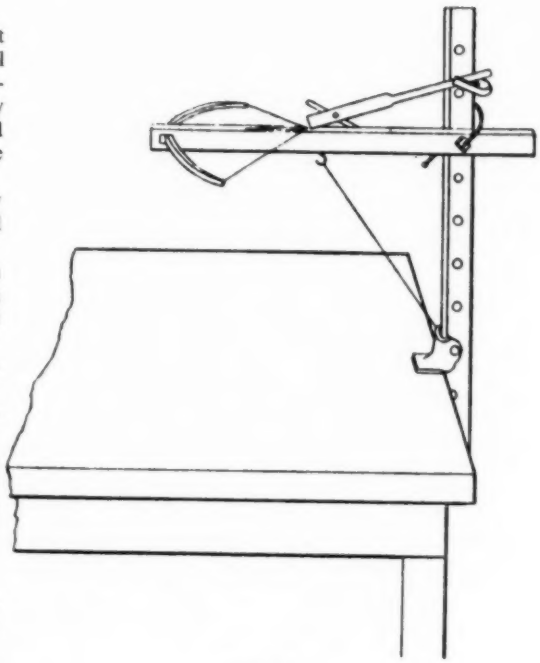

Fig. 5.

Crossbow Method

In Fig. 5 is shown a sketch of Boys' original apparatus. Its operation should be fairly obvious from the figure. A very simple crossbow which will work quite satisfactorily is shown in Fig. 6. The dimensions are not at all critical. The stock consists of a piece of soft wood about 2 ft. long by 2½ in. wide by 1 in. thick. A shallow groove needs to be cut in one edge for the arrow to lie in. This groove is approximately ¼ in. deep and ¼ in. wide. The arrow is easily made from a piece of wooden dowelling ⅜ in. in diameter and 9 in. long, and it should be weighted at the front with a short piece of brass tube. The point can be made from a 1 in. nail with its point sharpened up. In the tail of the arrow a short nail about ½ in. long should be driven standing up vertically, this is for attaching the fused silica rod. A corresponding nail should be driven in the stock for the other end of the fused silica rod. A useful and springy bow can be made from a metre rule, screwed with two screws at the front of the stock. Almost any thin strong cord will do as the bow string, and a little experimenting will show how taut it should be. To fire the bow a hole should be drilled at the rear of the stock vertically down through it, and of such a diameter that an ordinary blacklead pencil will pass easily through. This pencil is used to fire the bow. If the string is pulled back and the pencil pushed up through the stock the string can be slipped over it; when the pencil is withdrawn the bow will be fired. This arrangement is shown in Fig. 7. To produce

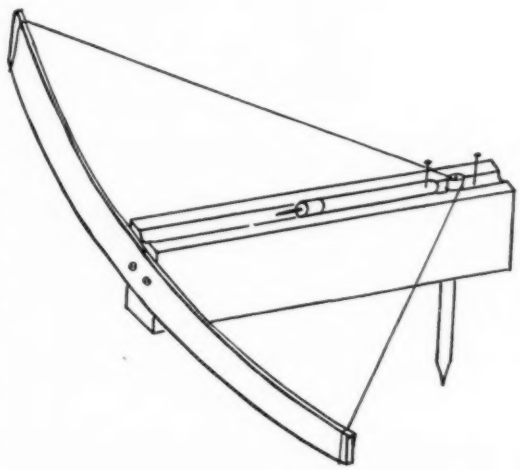

Fig. 6.

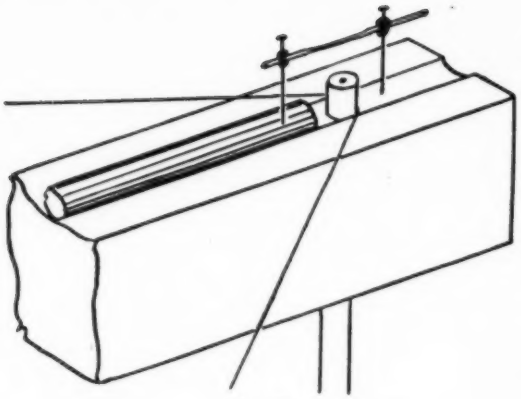

Fig. 7.

fibres the procedure is as follows: A fused quartz rod is drawn down to about 2 mm. in diameter. This rod should be as free as possible from small bubbles and striations, and should be attached with wax to the two nails, one on the arrow and one on the stock, when the bow is in the loaded position. An oxy-coal gas flame is now directed on to the middle of the silica rod and it is heated to as high a temperature as possible. One of the secrets of obtaining good uniform fibres by this method is to heat the silica rod so that it becomes really soft. When it is thoroughly softened the flame should be removed and almost simultaneously the arrow fired by withdrawing the pencil. It is advantageous to have another person fire the arrow so that both hands may be used to direct the blow torch accurately on the fused silica rod. The target should be soft wood, or building board, the type known as fibre board is suitable, as it is important that the target should be soft so that the arrow sticks in readily. If it is too unyielding the shock of the arrow striking it, even though it sticks in, may break the fibre and once broken it is difficult to locate again. If on the other hand the arrow sticks in the target with a comparatively small shock it will be found that the fibre can be seen as a continuous thread from arrow to bowstock. As an aid in seeing the fibre and also in keeping it clean, the bench between the target and bow should be covered with black paper. The matt black paper which is used as wrapping for photographic plates is ideal for this purpose, and large sheets can often be obtained from the X-ray department of a hospital or medical school where X-ray plates are used.

Methods of estimating the diameter of these fibres and of handling them will be described later. Fibres can be drawn by this method as long as 20 ft. or more.

Random Fibres Drawn Upwards

For the production of comparatively short fibres (50 cm. or less) the method of drawing rod rapidly apart in a flame and catching the fibres which are projected forwards and upwards on a nail studded board is a good one and easy to carry out. This is the method described by Boys, but we have found that a piece of black velvet or other black cloth with a pile or comparatively rough surface is rather better as a collector. The British Oxygen Co. lead burning torch should be set up with the stem vertical; the swan neck will then bring the flame at an angle of about 45° with the bench. The piece of velvet or other cloth should be attached to a board with drawing pins, and the board mounted horizontally or with a slight inclination to the horizontal, cloth side down. The exact distance from the flame will have to be determined by trial and error, but it is not very critical; a distance of about 3 ft. is usually satisfactory. An oxy-coal gas flame is sufficiently hot for the drawing of these fibres and the procedure is fairly simple. The flame should be adjusted so that a short fairly intense blue cone is produced and about a centimetre of rod is melted. A good size of starting material is clear silica rod of 2 to 3 mm. diameter which must be thoroughly cleaned before heating. The rod is now held in the two hands and the centre portion heated so that it becomes really soft. The hands are then separated rapidly, keeping the softened portion in the flame, and a fibre will be projected upwards and become caught on the black cloth where it will be clearly visible. The two ends of the rod may be melted together and the process repeated until several fibres are caught. This process will produce fibres of less than 1 μ (0·001 mm.) in diameter, but its disadvantages are that the fibres are short, and it does not allow of much control over the size or the reproducibility of the fibres.

(*To be continued*)

The Royal Institute of Chemistry

At the 81st Annual General Meeting of the Institute, held in Manchester on April 17, 1959, Mr. E. Le Q. Herbert was elected President for two years (1959-61), and took over this office from Dr. D. W. Kent-Jones (President, 1955-57), who had been Acting President since the death, on December 19, 1958, of Prof. W. Wardlaw, C.B.E. (elected President for 1957-59).

Dr. C. W. Herd, Prof. Charles Kemball and Mr. Clifford Paine were elected Vice-Presidents for 1959-61, in succession to Prof. H. V. A. Briscoe, Dr. John Idris Jones and Prof. R. G. W. Norrish, F.R.S., who had completed their two years of office. Dr. Norman Booth, Prof. Charles Gray and Dr. Frank Hartley are due to continue as Vice-Presidents until 1960.

Prof. Harold Burton was re-elected Honorary Treasurer for the ensuing year.

Seven of the twenty-one General Members of the Council had completed their period of service and, on the result of a postal ballot, the following were declared elected to serve for three years (1959-62): Mr. E. H. Coulson, Dr. D. C. Garratt, Prof. Sir Christopher Ingold, F.R.S., Prof. H. N. Rydon, Dr. Charles Simons, Prof. R. L. Wain and Dr. David Woodcock.

The new District Members of the Council for 1959-60 are: Mr. L. Balmforth, Mr. F. D. M. Hocking, Dr. S. J. Fletcher, Dr. R. E. Parker, Mr. C. C. Skou, Dr. M. B. Watson, Mr. P. N. Williams and Dr. W. Wilson. The other 12 District Members were serving in 1958-59 and have been re-elected for a further year.

NEW DEVELOPMENTS IN THE PHYSICAL CHEMISTRY LABORATORY

by S. Lewin, M.Sc., Ph.D.

Physical Chemistry Laboratory, South-West Essex Technical College, London, E.17

PART IV—IMPROVED AND NEW USES FOR LABORATORY STRUCTURAL SYSTEMS

THE present methods of holding burettes, flasks and similar objects utilize a stand plus clamp and boss arrangement. Such a combination is quite convenient when *movable* systems are involved. However, when several vessels have to be held at the same horizontal level, the use of a single stand is inconvenient and instead a horizontal rod, held in position by two stands and to which the bosses can be attached, may be employed. This arrangement is not rigid, but can be improved by screwing the stands on to the bench; the higher the position of the horizontal rod above the bench, the less rigid is the system. A better arrangement is to use laboratory scaffolding unit system made of rods and specially designed bench anchors or rod holders which are economic and commercially available. Being made of aluminium or rust resisting alloys and far more versatile than the two stands arrangement these are far more useful in the laboratory. Such systems have been in use for some time in this laboratory, but were found insufficiently rigid for several purposes, particularly where vibration was concerned.

In a continuously expanding laboratory, space is at a premium, and shelf-space is particularly required. A combination of shelf-space and rigid structure resulting in replacement of stands is therefore particularly useful, provided that it is economically reasonable. The author has consequently examined the possibility of more rigid structural units, such as those of slotted and perforated angle-iron, as combined shelving arrangement and stand-replacing unit. Such a double use reduces the cost considerably because several slotted and perforated angle-iron systems are commercially available at reasonable prices.

However, structures made of slotted angle-iron could hitherto be used for holding clamps in only a comparatively inconvenient fashion. Crude arrangements such as those in which one side of the angle-iron bar was held by means of an ordinary clamp have been considered temporarily expedient in several laboratories. The rod end of the clamp was then used as a base for the boss, which in turn was used to hold another clamp. Though convenient when nothing else is available, this arrangement is not stable. Consequently, several types of boss holders, similar to those of the ordinary stands and which are directly attachable to the angle-iron system, have been developed.

(1) Bolt-tube-nut System

This arrangement utilizes a 2 in. bolt, three washers, a closely fitting tube and one or two securing nuts. The system is shown in Fig. 1.

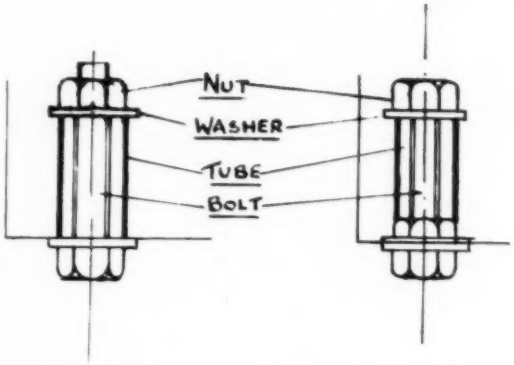

Fig. 1(a) Fig. 1(b)

The diameter of the tube should be sufficiently limited to allow the boss to be slipped on sideways without undoing the external nut.

Lengths of tubing are commercially available and can be cut to the required length. They should be made of aluminium, or some corrosion resisting alloy. If the bolt and the remaining components are not aluminium but iron, a fine smear of grease or some silicone may be used to decrease the chances of corrosion. The danger of corrosion of the iron in an iron/aluminium system is however comparatively small, because of the Al/Fe couple in which the aluminium, being positive, affords the iron protection from corrosion*. The tubing should be cut at right angles to its length and as accurately as possible to allow it it be gripped properly by the nut and bolt-head or the two nuts respectively.

(2) Studding-tube-nuts System

The rod length of the unit in the above system is limited by the length of the bolt commercially available for the diameter of the slot of the angle-iron. The length does not usually exceed 3 in. and is often smaller. The number of bosses that may be fitted on such a rod is therefore limited, and when thick bosses are used only one or two may be placed. However, it is often necessary to fit several thick bosses on to the same rod. To meet this condition, the studding-tube-nuts system has been developed.

*In such a couple the chances of corrosion of the aluminium itself—when not in direct contact with water—are nevertheless small because of the formation of the protective layer of aluminium oxide.

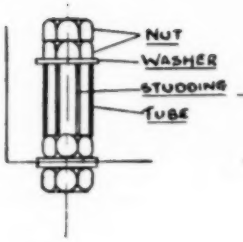

Fig. 2(a).

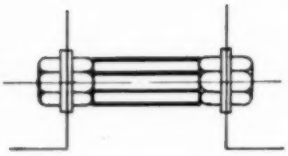

Fig. 2(b).

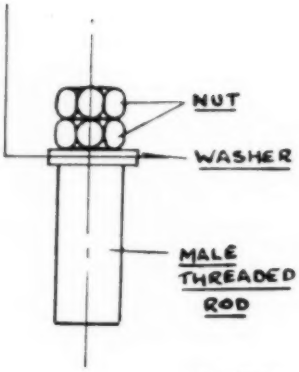

Fig. 3(a).

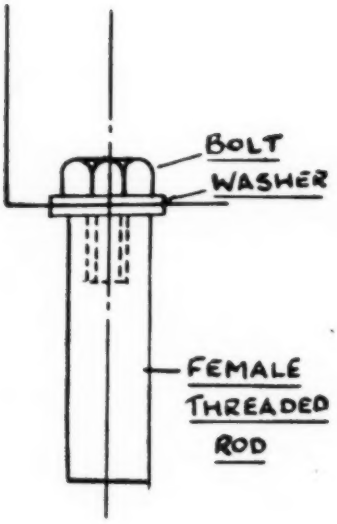

Fig. 3(b).

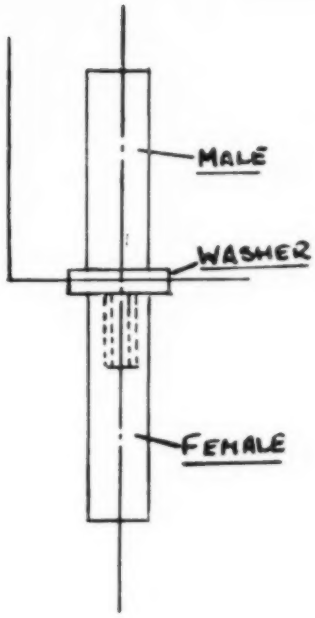

Fig. 3(c).

Metal studding of various diameters and lengths is commercially available. These can be cut to the required length using a small metal-saw and then fitted as shown, using the correspondingly smaller length of tubing and the required nuts. (Fig. 2a.)

The studding system may also be used for an additional function, viz. of mechanical strengthening or attachment of two angle-irons where considered advisable. (Fig. 2b.)

(3) The Threaded Rod System

The above systems, though readily obtainable and easily cut and assembled, may be considered excessive in their overall metal requirements, as both an internal (studding) unit and an external tubing are required. Further, if the tube is not cut at right angles to its length, it cannot be gripped properly by the nuts or the angle-iron, thus leading to unnecessary strains. A single unit in which the tube and studding are cast together to form a single rod is mechanically more stable and looks neater. To meet these points, the threaded rod system has been developed.

(*a*) *The male-thread-rod.*—A suitable length at the end of a metal rod having a diameter larger than that of the slot of the angle-iron is threaded in the lathe using a suitable die to form a threaded section. The external diameter of the section must be smaller than that of the slot so that its thread can be introduced into and past the slot readily, with the internal end of the thread-free rod pressing against the angle-iron or a washer in contact with it. The threaded section on the other side

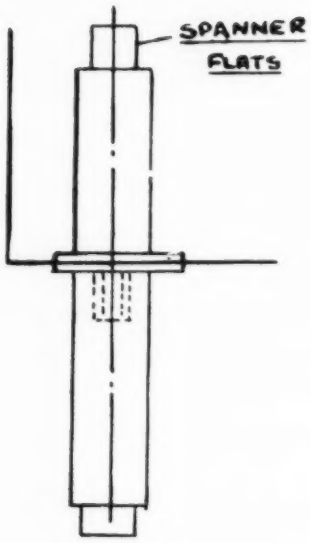

Fig. 3(c¹).

of the angle-iron is then locked with a nut and washer. (Fig. 3a.)

(*b*) *The female-thread rod.*—Instead of using a male-thread rod, a female-thread rod plus a bolt can be used. The rod to be tapped should, as in the previous section, have a larger diameter than that of the angle-iron slot. A suitable length—just longer than that of the projecting end of the bolt placed in the angle-iron—is drilled with a die giving the female thread corresponding to that of the bolt thread. The bolt is placed in the slot and the female thread rod is locked on to it. It is advisable to use washers on both sides of the angle-iron. (Fig. 3b).

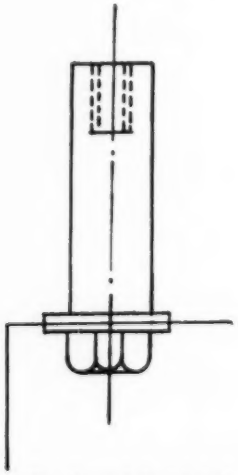

Fig. 3(d). Female ended rod locked in position but capable of extension.

The above male and female thread rods can be previously cut to the required length. Clearly, the assembling of system (3a) or (3b) is easier than that of (1) or (2).

(*c*) *Male-female thread rods combinations.*—Instead of using a male rod with a nut or a female rod with a bolt, the two may be combined via the angle-iron hole. (Fig. 3c.) The two may be easily screwed by hand. However, either rod can be easily machined or filed at the non-threaded end to give parallel faces which can be gripped easily with a spanner. Such a combination may then be easily dismantled or screwed in tightly by the use of two spanners. (Fig. 3c¹). The spanner-flats need not be as pronounced as shown in the figure, particularly as will be seen below, when it is considered advisable to drill a thread on that end. For this a slight flattening equivalent to a spanner $\frac{1}{4}$ BSF (or Whitworth $\frac{3}{16}$) was found to meet the turning requirements and therefore this can be recommended as a standard device.

(*d*) *Rod extensions and adjustments.*—Experience has shown that a given length of rod, fixed in a certain position and initially considered sufficiently long, may at a later date be found too short. It is possible to dismantle the original rod and to substitute for it a longer one. But there are occasions when it is far more convenient to place an extension on a rod without dismantling the original arrangement. A combination of female double thread and male double thread ended rods can be used (Fig. 3d). Alternatively, rods having both male and female thread ends may be used (Fig. 3d¹). Another alternative is to use only female double-ended rods and to join them by means of short sections of the correct thread studding (See alternative to 3d¹).

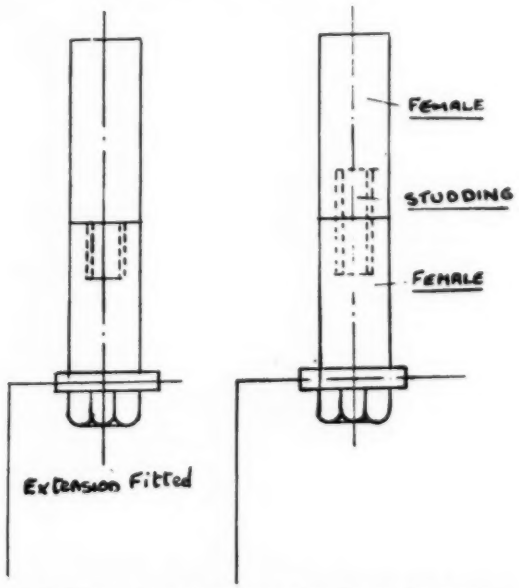

Fig. 3(d¹) (*left*) and (*right*) an alternative to Fig. 3(d¹).

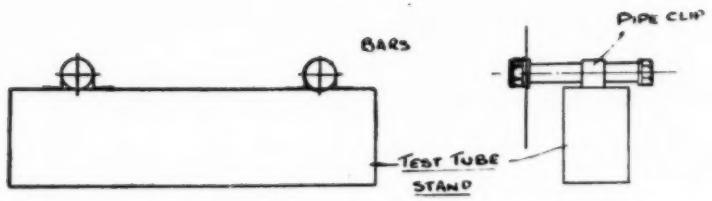

Fig. 4.

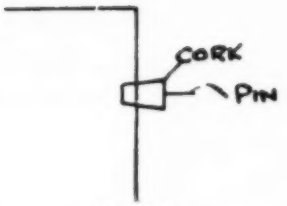

Fig. 5(a).

Experience has shown that while the above rods or their combinations were perfectly satisfactory when light weights were used, e.g. burettes or flasks, the use of heavier weights such as electrical stirrers resulted in the angle-iron tending to bend owing to the comparatively large leverage effect involved. This can be overcome with arrangements which involve a double, horizontally parallel, angle-iron system. The rods should then be threaded at both ends—whether male or female—and should be bolted or locked with nuts to the two angle-iron bars. already forming part of a given structure

Stand Holding Systems

It is often convenient to have glass tube stands which are capable of being placed on the bench when required, but which can also be suspended in a stable position from some available fixed structural system, thus leaving the bench free for other work. One such simple system has been developed. This uses a tube holder to which are attached two metal pipe clips arranged so as to fit easily on to two rods already locked or bolted on to a horizontal angle-iron bar (Fig. 4).

A similar arrangement may be employed for holding pipette stands in certain positions.

Board and Cork Holding Systems.

A given slotted and perforated angle-iron frame may be utilized for holding a cork-board or metal board lined with cork to which several papers may be attached by pins. Such an arrangement has been found very useful for notices, reminders or general information. A representation of it is given in Fig. 5b. In this the board is shown attached at four places. Instead of using a board, one may force pins into corks (or split corks) of suitable sizes which can then be inserted into the angle-iron holes with the pointed ends facing frontwise to hold sheets of paper. The corks containing the pins can be held strongly if forced into the holes (Fig. 5a).

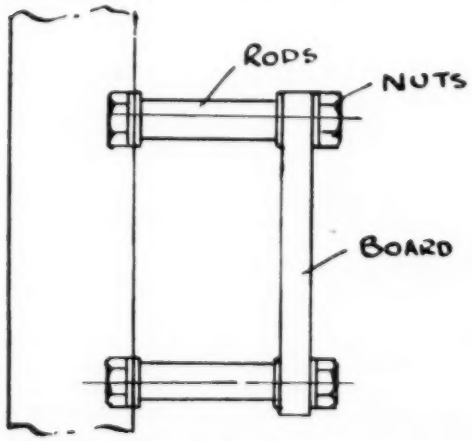

Fig. 5(b).

The above systems have been appended on to angle-iron systems which have been arranged to form shelves on top of the benches. Such systems were found very useful in that they have increased considerably the space available for storage and use of instruments. For example, in an acid-base titration where separate potentiometer, Weston cell, galvanometer and battery are used, the overall arrangement requires quite a proportion of bench space as well as a stand for holding the titration burette. However, when the galvanometer, Weston cell and battery are placed on the suitably arranged shelf and the burette is held by means of the system described here; the freed space, which is quite considerable, may then be used for other laboratory requirements. Further the galvanometer spotlight may be more conveniently observed when the galvanometer is placed on a higher shelf than on the bench. Additionally, the freed space may be used for thermostats and other allied equipment or instruments, the accessories of which no longer require stands which clutter up the bench, as they can be held or suspended directly from the angle-iron framework. It has been estimated that the use of the above shelving built on angle-iron systems and associated holders to replace stands has resulted in doubling the bench space available.

The above described rods were found useful in other ways, e.g. for holding pulleys. The rod to be attached to the angle-iron should have at its 'free' end a female thread. The metal bar on which the pulley rotates is male threaded to fit into the female thread of the free end of the rod.

Substitution of these systems for the common laboratory stand has resulted in further uses, e.g. labour saving. For example, both the rod and the base plate of the average laboratory stand, unless made of stainless steel or stainless alloys, tend to corrode owing to atmospheric oxidation or contact with liquids. Such corrosions can be minimized by regular attention to

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The Estimation of Physiologically Active, Naturally Occurring Substances in the Tissues and Body Fluids: Acetylcholine, L-Adrenaline, L-*nor*adrenaline, Histamine, Serotonin and Substance P.

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PART IX—5-HYDROXYTRYPTAMINE (SEROTONIN)

Introduction

Although the presence of a circulating substance with the properties of 5-hydroxytryptamine (5-H.T.) has been known since 1918[140], 5-H.T. was not isolated until 1948 by Rapport[141, 142] and almost simultaneously by Erspamer[143]. Unlike adrenaline, *nor*adrenaline, histamine and acetylcholine, 5-H.T. was isolated, identified and estimated by chemical methods, and the discussion which follows will show that chemical methods of estimation of 5-H.T. are as important as biological methods.

Before 5-H.T. was isolated, two schools of workers had been investigating quite independently the properties of what were believed to be two different naturally occurring physiologically active compounds. Rapport and his colleagues [141, 142, 144, 145] in the United States were trying to isolate and identify the principle which was responsible for the vasoconstrictor and moderately hypertensive properties possessed by serum and defibrinated blood; a substance which had been known for more than 40 years under various names such as 'vaso-constrictines' 'adrenalinähnliche substanz'[89] 'vasoconstrictor principle or substance'[140, 149, 153] 'spatgift'[154-156] 'thrombocytin or thrombotonin'[157-159]. Rapport and his colleagues [141, 142, 144, 145] finally obtained an active substance (which they called 'serotonin') in a pure state from beef serum and they later found this to be identical with 5-hydroxytryptamine creatinine sulphate.

The second school of workers was the Italian team led by Erspamer who with his colleagues was trying to extract, characterize and isolate the substance which imparts the peculiar histochemical properties to the enterochromaffin tissues of the gastro-intestinal mucosa [160-162]. They called this substance 'enteramine', because it appeared to be concerned mainly with the gastro-intestinal tract and gave the colour reactions typical of an amine.

Bacq[163], suggested that the names serotonin and enteramine should be dropped in favour of 5-hydroxytryptamine and this is now the generally accepted name of the substance, and is usually abbreviated to 5-H.T. or less often to H.T.

5-H.T. is formed in the tissues by the decarboxylation of 5-hydroxytryptophan, under the influence of an enzyme 5-hydroxytryptophan decarboxylase. This enzyme is widely distributed in the tissues, being found in brain, liver, kidney, lung and the intestines. It is highly specific and requires the presence of pyridoxal phosphate as co-enzyme. In the body, 5-H.T. is broken down to 5-hydroxyindolacetic acid (5-HIAA) which appears in the urine. The enzyme responsible for this conversion is called 'monoamine oxidase' which is found in the mitochondria. It is readily inhibited *in vitro* by iproniazid, and also by amphetamine and ephedrine. (Fig. 15.)

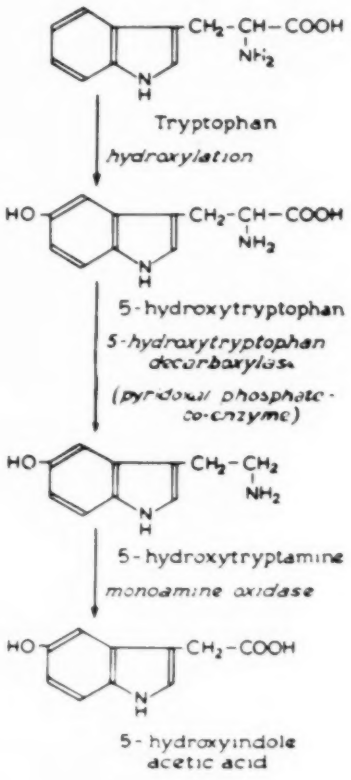

Fig. 15.

The presence of 5-H.T. is very closely linked with the enterochromaffin system and in consequence it occurs in the gastro-intestinal tract of mammals, birds, reptiles, amphibia and even the elasmobranchii and chondrostei. Its distribution in the gastro-intestinal tract

varies very much from one part to another and from species to species. All animals in which the gastro-intestinal tract contains enterochromaffin cells, have 5-H.T. in their blood, where it is found particularly in the platelets, and in the spleen, which is the major site of platelet breakdown. It is believed that the enterochromaffin system may function as an endocrine organ and its secretions may be involved in the control of smooth muscle tone. Besides being found in the gastro-intestinal tract, 5-H.T. is also found in the central nervous system in which the richest sources are the hypothalamus, the area postrema, mid-brain, colliculi, nuclei cuneatus and gracilis and the grey matter of the spinal cord. It is not found in the nucleus caudatus, cerebellum or white matter of the spinal cord, nor does it occur as a rule in the rest of the central nervous system. It is also found in the mast cells and thus in the skin, and it has been shown to be released during bronchospasm. 5-H.T. has also been found in many invertebrate animals, where it may be present in very large quantities, e.g. the salivary glands of octopods.

The physiological significance of 5-H.T. is still largely unknown, but we may note some of the more important theories. Its presence in the gastro-intestinal tract and the marked sensitivity to it of these tissues, particularly the ileum, suggests that 5-H.T. serves as a local hormone to regulate smooth muscle function. The vasoconstrictor action and its presence in platelets suggests a role in haemostasis[164] or that it may function to prevent haemorrhage, especially by increasing capillary resistance[165, 166]. However it has recently been shown that reserpine depletes the 5-H.T. content of platelets[167] while the presence of malignant carcinoid tumours can markedly increase the 5-H.T. content of platelets[168] without altering the bleeding or clotting times. Another role involving an effect upon the circulatory system, suggests that 5-H.T. depresses neurogenic vasomotor tone and consequently plays a part in the control of systemic blood pressure[169]. 5-H.T. has also been postulated to have a role in normal kidney function. Erspamer[170-172] claimed that it was a specific hormone controlling diuresis. However, others have not confirmed these observations, and recent work[173] indicates that the antidiuretic effect is mainly produced by reflexes from the thorax, which by altering the blood pressure, affect the blood flow through the kidneys. Finally, it has been suggested that 5-H.T. may have an important role to play in mental processes and that suppression of its action may result in mental disorders. This theory is based on the distribution of 5-H.T. in the central nervous system, and the action of certain of its inhibitors, such as lysergic acid diethylamide, but more recent observations have shown that quite potent 5-H.T. inhibitors do not cause mental disturbance when taken by man and this has tended to draw attention away from a role in mental activity. On the other hand iproniazid which prevents the enzymic breakdown of 5-H.T. is being usefully applied to treat depression and it is thought that its effectiveness may be due to the protection and consequent accumulation in the brain of 5-H.T. The clinical importance of 5-H.T. lies in the fact that it is the agent responsible for the pathological manifestations of the malignant carcinoid, a tumour of intestinal origin. Patients with this disease excrete very large amounts of 5-HIAA and a simple test for this substance in the urine is considered to be diagnostic of this disorder.

5-H.T. has so far no clinical applications; although its presence in the body is well established, its function there is not clearly understood. Its estimation from the point of view of diagnosis of disease is relatively unimportant apart from the estimation of high levels of urinary 5-HIAA in malignant carcinoid. However, its estimation experimentally is of great importance and may continue to be so; indeed, once its actual function in the body is established, its estimation may be of greater clinical importance.

There are several important reviews giving detailed information on 5-H.T.[171, 174-177] and these should be consulted for further information on the actions and significance of this compound.

As already mentioned, chemical methods of estimating 5-H.T. are as important as the biological methods and are probably as good. They are of particular importance for those laboratories, where for various reasons, biological procedures are not convenient.

Identification of 5-H.T.

As there is no single biological test object which responds specifically to 5-H.T., it is impossible to say definitely whether a response is due to 5-H.T. or is caused by some substance with very similar properties, particularly as the N-methylated derivatives of 5-H.T. are often found in nature. It is however usually possible to use the method of parallel quantitative assay (Lab. Practice, **6**, 329), and to compare the actions of the unknown with those of 5-H.T. on a number of tissue preparations. If the ratio of the potency of the unknown to 5-H.T. is constant, at least within experimental limits, it is then possible to conclude that the unknown is very probably identical with 5-H.T.

Lysergic acid diethylamide (L.S.D.) has been found to be a specific inhibitor of 5-H.T. on many test objects and its derivatives on mammalian tissues and also on invertebrate tissues, and will show if the unknown substance is closely related to 5-H.T. A further test may be carried out on the guinea pig's isolated ileum. Gaddum[178] showed that if a dose of 5-H.T. is left in contact with the ileum, the contraction produced disappears in a few minutes in spite of the continued presence of the drug. The gut is then insensitive to further doses of 5-H.T., but will still respond normally to other drugs, except tryptamine, which is believed to act on the same receptors.

Chemical methods for the identification of 5-H.T. appear on the other hand to be more specific, especially those which involve the use of paper chromatograms. Shepherd, West and Erspamer[179] described a method which made use of a solvent mixture of butanol-

acetic acid-water and in which the resulting paper chromatogram was developed with a mixture of 9 parts potassium dichromate (0·1 per cent solution) and 1 part formaldehyde (37-41 per cent solution). After spraying the paper with the developer, it was heated to 100°-110° for five minutes. The paper was then viewed under ultraviolet light, when immediately after heating 5-H.T. shows up as a golden-yellow fluorescence (Rf.O.38). The fluorescence persists for several days. As little as 0·2 μg. of base can be detected. Bufotenine (N:N. dimethyl 5-H.T.) and bufotenidine (a compound closely related to 5-H.T.) give a similar effect. Tryptamine and tryptophan give a bright yellow fluorescence, which develops slowly, if >2·5 μg. are present, while 5-methoxy tryptamine gives a yellow-orange colour if >2·5 μg. are present. Adrenaline and *nor*adrenaline give a very feeble fluorescence and all other compounds likely to be present in tissue extracts give no fluorescence. 5-H.T. bufotenine and bufotenidine can be distinguished from tryptamine by developing the paper chromatogram with a diazotized *para*nitraniline reagent.

Jepson and Stevens[180] modified this method with the object of making it more specific and more sensitive. They used as the developer an acetone solution of ninhydrin (0·2 per cent) containing 10 per cent v/v glacial acetic acid, allowed the acetone to evaporate, then heated the paper to 90° to 100°C. for 2 to 3 min., and examined it under ultraviolet light. The method is specific for tryptamine, 5-H.T. α-methyl tryptamine and α-ethyltryptamine. Sensitivity is as low as 0·02 μg. of compound/sq. cm. of paper.

Spot Tests

Spot tests for 5-H.T. in enterochromaffin tissues have often been used[181, 182]. These depend on the fact that after fixation of the tissues in formalin, 5-H.T. forms a compound which gives a golden yellow fluorescence under U.V. light.

Antagonists

Gaddum and Hameed[183] investigated the ability of several compounds to inhibit the actions of 5-H.T. on isolated tissues and organs. They found that on the rat uterus, lysergic acid diethylamide (L.S.D.) was the most potent inhibitor of the response due to 5-H.T., a concentration of L.S.D. of 3 μg./l. causing complete inhibition of the response of the uterus to 16 μg./l of 5-H.T. In decreasing order of potency dihydroergotamine, dihydroergocornine and dihydroergokryptine also inhibited the action of 5-H.T. Gramine (3-dimethylaminomethyl indole) also inhibited the response of 5-H.T. on the uterus.

On the rabbit's ear preparation, L.S.D. was a potent inhibitor of the vaso-constrictor actions of 5-H.T. If the ear was perfused with a solution containing 10 μg./l. L.S.D. the response of the blood vessels to a 500-fold increase in the 5-H.T. concentration was inhibited. This was not, however, a specific effect and the response to adrenaline was also reduced although not to such a marked extent. Dihydroergotamine also inhibited the response to 5-H.T. and adrenaline. On the guinea pig's ileum the actions of the ergot alkaloids were found to be feeble and not specific. While a concentration of 100 μg./l. L.S.D. reduced the response by about 50 per cent, a concentration one hundred times greater had no further effect.

From these results and from the use of adrenaline antagonists and potentiators, etc., Gaddum and Hameed concluded that there were two types of tryptamine receptors: (*a*) those in the plain muscle of the rat's uterus and rabbit's ear which are easily paralysed by L.S.D. but not by an excess of 5-H.T. and (*b*) receptors in the ganglia of the intestine which are easily paralysed by excess 5-H.T. but not by L.S.D.

Gaddum and Picarelli[184] later showed that there were two kinds of tryptamine receptor in the guinea pig ileum. The M receptors which are blocked by morphine and the D receptors which are blocked by dibenzyline. L.S.D. blocks the D receptors, which are probably in the muscle. The M receptors are probably in the nervous tissue.

Extraction of 5-H.T.

5-H.T. can be extracted from tissues by mincing and grinding in acetone and re-extraction of the residue with 95 per cent acetone[185]; 20 volumes of acetone should be used. If smaller quantities of acetone or acetone containing more than 5 per cent of water are employed, other substances, in particular substance P., will also be extracted[185]. The problem of the extraction of 5-H.T. from blood (where 5-H.T. is found predominantly in the platelets) is difficult because of the nature of the distribution of the platelets. The best method[186] involves the removal of blood by means of a siliconed syringe and needle and its transfer to a siliconed centrifuge tube containing either disodium ethylenediamine tetra-acetate (1·0 g./100 ml. of 0·9 per cent NaCl) or sodium citrate (3·1 g./100 ml.) in the proportion of 1 part to 9 parts of blood. The contents of the tube are mixed by gentle inversion and then centrifuged for 10-20 min. at 100 xg. This gives a platelet rich plasma. To determine the 5-H.T. content of this or of serum or whole blood, 1 vol. is mixed with 19 vol. of acetone and left overnight in the refrigerator. After filtration, the precipitate is re-extracted and washed with 95 per cent v/v acetone. Acetone is removed from the combined filtrates *in vacuo*, at a temperature not greater than 35°. The residue is assayed for 5-H.T. Bracco *et al.*[187] have developed a method for extracting 5-H.T. from platelets.

Urine

Direct assay of urine samples on the heart preparation of *Venus mercenaria* has been used[188]. However, the chief interest is not so much in the urinary content of 5-H.T. itself, but in that of its metabolite which occurs in urine, 5-hydroxyindole acetic acid (5-H.I.A.A.) which is assayed colorimetrically.

Biological Estimation

Standard.—The standard preparation against which all samples are assayed biologically, is a pure crystalline preparation of 5-hydroxytryptamine creatinine sulphate, which is a molecular combination of one molecule of 5-H.T. with one molecule of creatinine and one molecule of sulphuric acid, and contains 45·37 per cent of base. This is a stable, pure crystalline compound.

Methods

Rat Uterus.—This preparation was first used by Erspamer[189] to assay an unknown compound obtained from tissue extracts, which he called enteramine, and which latter turned out to be 5-H.T. In this method, ovariectomized rats were used. These rats were given daily injections of oestradiol propionate for two days prior to use. The uterus is suspended in an 8 ml. organ bath containing Tyrode's solution at 36·5 to 37·5°. This method was considerably modified by Amin, Crawford and Gaddum[185], who found that it was unnecessary to ovariectomize the rats prior to use. However, Erspamer still uses a modification of his original method[190, 191].

In the method of Amin, Crawford and Gaddum[185] virgin female rats weighing 160-200 g. are given a subcutaneous injection of stilboestrol (0·1 mg./kg in arachis oil) 24 hr. prior to use. The animals are killed by a blow on the head, and the throat cut. Both horns and body of the uterus are removed and placed in a petri dish containing de Jalon's solution[192] (NaCl 0·9 per cent; KCl, 0·042 per cent; $CaCl_2$ anhydrous, 0·006 per cent; $NaHCO_3$, 0·05 per cent; glucose, 0·05 per cent). All fat and extraneous tissue are carefully removed. A piece of one horn of the uterus about 2·5 cm. long is taken and a loop of cotton tied on to each end. It is then suspended in a 2 ml. organ bath containing aerated de Jalon's solution, to which atropine sulphate (1 mg./l) has been added. The temperature of the bath is kept at 30°. Lever magnification is 10 and the weight on the tissue about 1 g., a four minute time cycle is used allowing the drug to be in contact with the tissue for 30 sec. This preparation should respond to doses of as little as 10-20 ng. of 5-H.T. Large doses (100 μg.) of histamine are feebly inhibitory to this tissue.

If the tissue shows much spontaneous activity, this may be reduced by lowering the bath temperature, or, by further decreasing the calcium content of the solution. If it still shows spontaneous activity, it should be rejected and a fresh animal used. It will usually be found, that if one horn of the uterus is unsuitable, the other horn will also be unsuitable.

Many tissues may contain adrenaline as well as 5-H.T. and during extraction of these tissues with acetone, some of the adrenaline is also extracted. As the rat uterus is extremely sensitive to inhibition by adrenaline in particular and also to *nor*adrenaline, the estimate of 5-H.T. may be too low. A method has recently been described[193], which uses a polyphenoloxidase present in mushroom juice to eliminate all interference by adrenaline and *nor*adrenaline.

Fresh edible mushrooms (*Psalliota campestris*) were used to prepare the juice as follows. 120 g. fresh mushrooms were sliced and then ground using a household mincer. The pulp was ground in a mortar with about 10 g. silver sand for 20 min. and the juice squeezed out through linen by hand. This yielded 80 ml. of a slightly frothy, dark brown turbid fluid. After storage overnight at 5° it was distributed as 0·5 ml. samples in separate test tubes. The samples were freeze-dried under reduced pressure over phosphorus pentoxide. The tubes were then sealed and stored at 5°. This residue readily dissolves in water to give a slightly turbid solution. For use the contents of each tube were made up to 5 ml.

For the treatment of tissue extracts, some of this aqueous solution (0·25 ml./1 ml. tissue extract) was added to the aqueous solution of the residue from the acetone extract, allowed to stand for 40 min. and then assayed for 5-H.T. activity on the rat's uterus in the normal way. The pH of the samples was always between 4·5 and 6·0.

The method of Erspamer[189-191, 194] has now tended to be replaced by a technique using the isolated rat's colon[195]. In a critical comparison of the method described above and the method involving the use of the rat's colon, it was found[196] that the rat's uterus was as reliable as the rat's colon but the technique was a little more laborious. In addition, one in every three uteri had to be rejected, and the method was also found to be slightly less sensitive than that using the colon.

(*To be continued*)

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HOSPITAL LABORATORY WORKING CONDITIONS

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THE growth in routine work in a hospital laboratory has made necessary the application of the principles of industrial welfare. Too often we find cramped, dirty, ill-lit chemistry laboratories originally intended as a pathologist's side-line but now offering such working conditions as would bring strong disapproval from an Inspector of Factories.

Cleanliness

The Factory Acts decree that all workshops should be whitewashed or the walls cleaned every 14 months and we might well copy the latter. By cleaning is meant not the mere removal of grime but the destruction of bacteria and thus repainting is advisable or at least the use of washable paint. Apart from hygiene, a dingy workshop has a depressing effect and leads to untidiness which is next to lack of cleanliness and so initiates a vicious circle. Untidiness is again a danger in that gangways get blocked up and fire hazards are increased. A little paint at the right time would help to avoid all this.

All laboratories should have adequate washing accommodation with soap and towels freely available. Too often the washing-up bench has to serve personal needs which is undesirable in a pathological department, handling as it does infectious material and corrosive chemicals. Liquid soap is a useful expedient if the tablet type tends to disappear.

Personal clothing is a problem in the cramped conditions of today. There should be somewhere where outdoor garments can be kept clean and dry. Individual lockers are the ideal but are expensive and occupy valuable space. A row of clothes hooks in a little used room are a good solution and are far better than the odd hook behind the door.

Heating and Ventilation

The minimum legal space for each individual worker is 400 cu. ft. Generally, space is adequate from a three dimensional point of view but people tend to get crowded round one end of the room and this leads to lack of elbow space with consequent irritation. Again congestion of apparatus and machinery can be just as trying if not actually dangerous. Adequate ventilation is, therefore, of primary importance.

Still air should be avoided at all costs. A movement of 30 to 40 ft., of air per minute is the ideal and it is unnecessary to emphasize this must be warm, not cold air, for there is nothing worse than a draught. Air movement is necessary to make use of natural body temperature controls, otherwise discomfort arises with lassitude, 'nerviness' and oversensitiveness to cold. If open windows cause a draught, then fans at least should be in use.

Conversely, one should be able to keep cool in summer. As an aid to this, thick walls and a lined roof can do much as well as keep the place warm in winter. Roofs should be painted white and in extreme conditions a roof shield may be necessary and cool air blown into the room. Any pipes or other hot metal fittings should be lagged and covered with white metal foil to reduce radiation.

The humidity factor should not be neglected. A hot room is unpleasant but if also damp it is unbearable. All steam baths and exit pipes should have a hood with extraction fan as for obnoxious or corrosive fumes.

The ideal working temperature is low enough to be compatible with comfort—it is better to be too cool than too hot. The ideal temperature is 60-65°F. for light work as in the laboratory. A chilly room leads to clumsiness while a stuffy one leads to sleepiness. The walls and surroundings should preferably be at a higher temperature than the air otherwise a sharp temperature gradient is introduced. The feet should be warmer than the head and any infra-red radiation on the face from heaters should be avoided as this leads to headaches and general naso-pharyngeal discomfort.

There are many types of heating apparatus. Hot water pipes have the advantage over fires and stoves of absence of fumes but they often make the rooms stuffy. Steam heaters have the infra-red radiation defect mentioned above. Perhaps the most convenient type with none of the disadvantages so far mentioned is the unit heater which blows hot air into the room. The ideal, however, appears to be the panel heater system incorporated in walls and ceilings but this is usually only economical when incorporated in the original building operations.

Lighting Efficiency

Poor illumination leads to eye-strain and eventually bad health resulting in absenteeism. Incorrect illumination reduces efficiency and increases accident hazards. Not only may the light be insufficient in quantity but it may be too diffuse, making it difficult to distinguish objects from their surroundings. On the other hand, over-sharp shadows are to be avoided too. Glare is even worse and may be due not only to over-bright lights but to excessive contrast. A bright window in a dark wall or low unscreened lamps either set up a strain by attracting one's eyesight from the work in hand or contract the eye pupils and so diminish the ability to perceive detail. The cure for this lies in the correct placing of main lamps with adequate shading or provision of reflector surfaces, the making of smaller lights and the dulling of bright surfaces. Above all, contrast should be avoided with the aid of white paint on dark surfaces.

While it does not need emphasizing that flickering,

unsteady or wrongly coloured lights are undesirable, perhaps a word on the units of light measurement will not be out of place. The standard light unit is the candle which originally depended on the burning of a precise weight of pure wax in a given time. The intensity of light falling on a surface one foot from a light of one candle power is the standard unit of illumination and is known as the foot-candle. This intensity varies inversely as the square of the distance and thus for example becomes a quarter foot-candle at two feet from the unit light. More practically, at five feet from a 100 candle-power lamp, the intensity is only four foot-candles but the brightness of an object at five feet depends on its colour which, if dark, will considerably reduce this. It follows from this that a white room needs the least lighting and heavy colouring or dirty walls and ceilings mean wasted light.

An ordinary wire lamp gives lighting to the value of one candle for about every $1\frac{1}{4}$ watts. A 60 watt lamp therefore provides about 50 c.p. This means a book at five feet gets an intensity of say two foot-candles. This should be compared with the legal minimum standard factories of six foot-candles at three feet above floor level. The recommended intensity for laboratories is 10 foot-candles and today it is easier to obtain this over a wide area with modern fluorescent lighting.

On the whole, the lighting should be so arranged as to approximate daylight as closely as possible, with upper surfaces, as in a wall panel, brighter than lower. When large areas of low illumination are unavoidable, small localized lights of low voltage can be of use as they are portable and have no shock or fire risk.

Attendance to the above points together with consideration of individual working posture or approach to the task in hand, can do much to banish the bogey of bad lighting.

Colour Schemes

A little realized influence on output is the colour of the surroundings. Most persons are highly responsive to colour, often more so than they themselves realize. Colour in a work-room makes for aesthetic satisfaction and invigorates mind and body, minimizing accident risks and reducing boredom.

The dull grey tones of machinery are a legacy from the dark days of sweated industry. Modern apparatus tends to be turned out in bright tints with multi-coloured pipelines and electric leads. The room itself need not be a drab yellow or brown. Delicate creams, buffs, greens or even peach or pale pink may be the principal tints for wall panels. It must be remembered, however, that anything much deeper than white leads to some loss of light and furthermore the eye expects the brightest tones to be higher up. Bright red is to be avoided; likewise, strong blue or blue-grey are offensive as they have a depressing effect as does deep brown or any heavy shade.

The cramped nature of some chemical laboratories need not preclude the sensible use of colour. As such laboratories are preferably built with a northern aspect, it is wiser to remember that touches of orange, yellow or even red can do much to give a sensation of warmth.

Noise

The constant clamour of centrifuges, fans and even roaring bunsens are to some extent accepted as the natural atmosphere of a laboratory. Perpetual loud noise can be tolerated within quite wide limits but it is the sudden, unexpected noise such as the intermittent slamming of doors which can be a nuisance. It should always be realized that workers require a fairly quiet room if any reading or written work is to be carried out. What is more important is that they should be able to do this without interruption of either mechanical or human nature.

Working Posture

Least fatigue is caused if some of the day's work is done sitting, some of it standing and some of it walking about. The more nearly it can be contrived for workers, especially young workers, to have variety of this kind the better, provided it does not entail unconsidered and unexpected switches from one job to another, which most workers dislike and resent.

Even where complete freedom of choice for the individual is out of the question, it should still be possible to allow alternatives between sitting, standing and walking.

Benches should not be of uniform height, and the exact distance between floor or chair and bench is of significant psychological importance, particularly in repetitive work. Tall benches accommodate ovens, water baths or other equipment only visited occasionally and must be high enough to allow easy access to the apparatus. Again, a certain amount of routine activity such as reagent adding can be carried out standing and this requires height as does washing-up. On the other hand, use of instruments with an eyepiece, writing and reading necessitate a table or low bench preferably and this means the provision of proper chairs. Stools, whether padded or hard, or of whatever height, are considered by some workers to be out-of-date. All seating should have proper shaping to fit the body using it and an adjustable back rest prevents rounded backs and cramped stomachs. High or low chairs with shaped leather seats are ideal and do much to minimize fatigue.

Where work is done standing some thought must be given to the nature and condition of the floor. Stone, concrete or tiled floors are usually a misery from the comfort angle, a danger from the accident angle and expensive from the breakages angle and should be avoided. Boarded or lino floors are warmer and less liable to shatter any fragile apparatus coming into contact with them. For prolonged standing, as when washing up, some changes of posture of the feet is necessary just as a change is needed from time to time when sitting. Flat flooring should give way in this case to an irregular surface such as a slatted 'duck-board'.

Such a floor allows variation of pressure on the sole without any of that restless seeking for a fresh angle of support noticeable on a dead level surface.

With regard to walking, most hospital laboratories require a good deal of 'running about' and footwear is important. Heavy shoes are a bug-bear to the wearer (and the sound of them to his colleagues) and lighter footwear such as plimsolls or even slippers should not be frowned upon. Apart from the saving in actual shoe repairs, the use of plimsolls makes a remarkable reduction in fatigue; if visions of fallen arches or other pedological disorders are brought to mind, it is quite possible to obtain a pair of 'gym-shoes' with a definite heel.

Working and Resting

Nowadays it is generally recognized that a man will not do twice as much work in two hours as in one. Increased output is not directly related to the time available. In every class of work there is an optimum maximum for hours of work, in the day and in the week. If that optimum is exceeded the output per hour falls and it falls so fast that very soon a reduced total of work is done in the greater number of hours than in the less.

If a graph be plotted of output against time it will be seen that the greatest amount of work is done as meal breaks or the end of the day approaches. The moral from this is that it is not the length of the break which is important but the frequency of the breaks. The mid-morning and the tea breaks should be a definite interval which need not exceed ten minutes. If possible, a change of scene is all to the good and one cannot but feel that a plea for some provision for laboratory staffs in the shape of a rest-room where the break can be taken is not pushing welfare to the point of pampering.

The author wishes to express gratitude to Mr. C. C. Plimbe for his book, 'Factory Well-Being', which inspired this paper.

Forthcoming Conferences

S.A.C. in Belfast

By courtesy of the Chancellor, Queen's University, Belfast, and at the invitation of the Department of Chemistry, a joint meeting of the Polarographic Society and the Scottish Section of the Society for Analytical Chemistry will be held in the University, on Friday, June 26, 1959. Papers will be presented between 10 a.m. and 12.30 p.m., and 5 p.m. and 7 p.m. in the Lecture Theatre of the Department of Chemistry.

In the afternoon there will be a tour of the Laboratories of the new Chemistry Building of the University.

The programme of papers is as follows:

1. 'The Polarographic Investigation of Some Copper Complexes in Non-aqueous Solution'. Dr. Z. Zigoriski (Chemistry Dept., Q.U.B. and University of Poznan, Poland).
2. 'Aspects of the Polarographic Behaviour of Rhenium and Technetium.' Dr. R. J. Magee (Chemistry Dept., Q.U.B.).
3. 'The Application of Polarography to Tissue Respiration.' Dr. I. S. Longmuir (Institute of Diseases of the Chest, London).
4. 'A Potentiometric Method for Acid-base Titrations in Certain Acetone-water solutions.' Mr. G. F. Reynolds (Chemical Inspectorate, Woolwich Arsenal).
5. 'The Polarographic Determination of Nitroglycerine.' Mr. A. F. Williams (I.C.I. Ltd., Nobel Division).
6. 'Polarography in Fused Salts.' Mr. R. L. Faircloth (U.K.A.E.A., Harwell).

A limited amount of accommodation will be available as required in University Hostels; if hotel residence is preferred, intending delegates are requested to make their own arrangements.

Anyone intending to be present at this meeting should notify Mr. J. Brooks (Hon. Secretary, S.A.C., Scottish Section), Analytical Research Section, Research Department, I.C.I. Ltd., Nobel Division, Stevenston, Ayrshire, stating whether University Hostel accommodation is required.

*

British Association for the Advancement of Science

The 121st meeting of the British Association for the Advancement of Science will be held in York from September 2 to 9, under the Presidency of Sir James Gray, C.B.E., M.C., F.R.S., Professor of Zoology in the University of Cambridge. The title of his Presidential Address will be 'The Proper Study of Mankind is Man'.

No scientific qualifications are required for membership and all who are interested in science and its impact upon society can join the Association and attend the meeting without any formalities.

Copies of the preliminary programme may be obtained without charge from the Secretary, British Association, 18 Adam Street, Adelphi, London, W.C.2 or from the Local Honorary Secretaries, British Association Office, Guildhall, York.

Society for General Microbiology

The 29th General Meeting of the Society for General Microbiology will be a joint meeting with the Netherlands Society for Microbiology at Utrecht, Holland on Friday and Saturday, September 25 and 26, 1959. Papers on any subject of microbiological interest will be welcome but contributions, either reflective or describing original work, on the following subjects are specially invited:

(*a*) Carbohydrate metabolism of microbes.
(*b*) Streptococci.
(*c*) 'L' forms.
(*d*) Influence of environment on survival.

Those who contemplate making a contribution on one of these subjects or presenting a paper should communicate with the Meetings secretary as soon as possible.

Such communications should be addressed to K. E. Cooper, Department of Bacteriology, Whatley Road, Bristol, 8 or B. W. Lacey, Department of Bacteriology, Westminster Medical School, London, S.W.1.

New Developments in the Physical Chemistry Laboratory.

(*Concluded from page* 211)

cleanliness and treatment. However, owing to the considerable amount of work necessary in the laboratory, this tends to be neglected. The smaller rods can be made comparatively cheaply from aluminium or other corrosion-resisting materials, thus saving time and money and avoiding aggravation.

ACKNOWLEDGMENTS.—*I wish to thank Mr. C. P. G. Bateman, G.I.Mech.E. for the assistance given in drawing and Mr. E. J. Prince for assistance given in making to my specifications some of the units described.*

A LABORATORY DE-IONIZING PLANT

by D. H. Constable

University College of Ghana, Faculty of Agriculture

IN a recent article Lorch (1958) has given a detailed description of the various de-ionizing processes available for producing high purity water.

These may be summarized as:

(*a*) Monobed processes in which regeneration is simple and inexpensive but which gives water of only a moderate purity.

(*b*) Mixed bed processes giving water with a specific resistance of the order 1 to 4 $\times$ 10^6 ohms/cm. With these, regeneration in the laboratory is somewhat of a nuisance as it involves flotation separation of the constituents before regeneration and a thorough remixing afterwards.

This difficulty may be overcome by using replaceable cartridges which are discarded on exhaustion but this appears to be a comparatively wasteful process.

Commercial literature from mixed bed ion apparatus manufacturers suggests that in very hard water areas single distilled water should be used to supply the mixed bed cartridge thereby ensuring long cartridge life. This appears to be a negation of most of the advantages of the ion exchange process except that of obtaining very high purity water which in any case is only rarely needed.

Faced with this problem under tropical conditions where replacement services are not immediately available the writer decided to substitute, for distilled water, monobed de-ionized water.

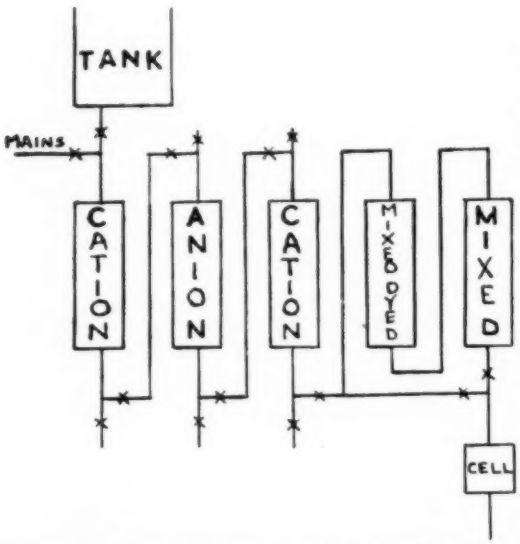

Fig. 1. Flowsheet of laboratory de-ionizing plant.

Tests on monobed water showed that a two column system cation/anion tended to produce water of relatively high conductivity. A three column system, cation/anion/cation was substituted and produced water with a steady value better than 1 $\times$ 10^5 ohms/cm. This when fed to a mixed bed column gave water with a steady value better than 2 $\times$ 10^6 ohms/cm. As regeneration of the mixed bed is an item requiring skilled supervision it is desirable to ensure that the water supplied to the mixed bed is of the highest possible purity. For this and other reasons a number of improvements have been embodied in the original design which will be described.

The apparatus is provided with the usual type of conductivity meter and cell in the output line. This cell has two sources of supply (*a*) the mixed bed effluent, (*b*) the final monobed effluent. Whenever the apparatus is started up the mixed bed is closed and effluent taken and metered from the monobed. This effluent is stored in polythene for reasons to be described later. When the monobed effluent resistance reaches 1 $\times$ 10^5 ohms/cm. the effluent is passed to the mixed bed and taken from there. Similarly at the end of each run, or at an intervening point if large quantities of water are being drawn continuously, the monobed effluent is again metered. By this means it is ensured that the minimum strain is placed on the capacity of the mixed bed.

The mixed bed resins used are of the dyed kind so that early information is given of 'breakthrough' in the monobed sections. This particular refinement can be further improved by having two consecutive cartridge type mixed bed deionizers the first of which is dyed and the second optional. Regeneration is then normally done in the first cartridge only, the second one serving as a safety precaution in case the colour exhaustion in the first is overlooked for a while, with a possible contamination of a large quantity of purified water.

The supply of water to the whole apparatus is from two sources: (1) directly from the tap, (2) from a small storage tank. Into the latter are poured any partially purified waters available, these being principally the effluent from monobed testing and stabilizing, but rainwater may also be used (Hewitt, Tech. Comm. No. 22, Comm. Bureau of Horticulture and Plantation Crops) if the laboratory concerned is sufficiently clear of town aerial contamination.

The final form of the apparatus is shown diagrammatically in Fig. 1.

The modifications 'and precautions may appear a trifle elaborate but they allow the process to be operated by very unskilled assistance and with the maximum efficiency as regards ratio of output to time wasted on regeneration.

A final point may be made for the benefit of those wishing to build their own de-ionizing plant. De-ionized water has a specific resistance greater than 2×10^5 ohms. Commonly any value above 5×10^5 ohms. may be taken as showing that the mixed bed is operating satisfactorily. The cells supplied with ordinary conductivity outfits frequently have constants greater than 1 and therefore require a high sensitivity meter. Cells of constant 0·5 are listed in United Kingdom catalogues but the writer has not seen any of a higher sensitivity. The Barnstead Corporation of America manufactures a distilled water cell with a constant of 0·1 (at a cost of about 35 to 40 dollars) which permits the use of low sensitivity bridges including telephone detector types reading to 50,000 ohms.

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A Modification of the U-Tube Gelometer for Following the Processes of Clotting of Small Samples of Blood

by G. W. Scott Blair, M.A., D.Sc., F.R.I.C., F.Inst.P. and J. Burnett

Physics Department, National Institute for Research in Dairying, Shinfield, Reading

Introduction

In a recent article in this journal, the authors (1957) described a U-tube gelometer suitable for studying the changes in elastic and viscous properties of soft gels. The method has since been used (Scott Blair and Burnett, 1958 a, b; 1959 a, b.) to investigate the changing properties of milk as it sets into curd (junket) under the influence of rennet. It has also been shown that the same technique can be applied to follow the clotting of blood (Scott Blair and Burnett, 1959c).

This apparatus, however, normally requires 50 ml. of sample and, although it is possible to reduce this amount somewhat without redesigning the gelometer, in studying the clotting of blood or plasma of both man and other species, it is often a very great advantage to be able to work on small samples, say not more that 1 ml. The apparatus here described is a modification of the original gelometer, adapted to such quantities. Somewhat unreliable results can be got with samples as small as 0·5 ml. but, though the micro-gelometer is never as accurate as the full-size apparatus, quite good data can be obtained with 1 ml. of blood.

Principles of the Method

As in the larger apparatus, the sample is contained in a U-tube. In the micro-apparatus, this consists of a carefully bent piece of glass tubing of even bore of about 3 mm. Blood clots more quickly when in contact with glass surfaces and it is therefore necessary either to take the sample in a paraffin or silicone treated syringe and to use a similarly treated U-tube, or alternatively to contaminate the blood very thoroughly with glass beads before filling the U-tube. If this is not done, the blood sets first against the glass wall of the U-tube, the setting process proceeding inwards, making determinations of the elastic modulus impossible. *Some blood clots do not adhere well to glass and it is therefore advantageous to roughen the surface of the U-tube by means of hydrofluoric acid.

*The authors are not yet satisfied with the reproducibility of either of these methods. Much work is yet to be done on how best to treat the blood between the time of drawing and the start of coagulation.

The first few ml. of blood should be discarded because they may be contaminated with tissue juice which affects the clotting (Lalich and Copley, 1942). Either the blood may be run from a syringe straight into the U-tube, placed in the thermostat and tested immediately, or clotting may be temporarily inhibited by lowering the temperature or by anticoagulants until it is convenient to start the test. Details of this very important part of the procedure will be published elsewhere. It is extremely important that, from the start, the menisci of the blood should be held *quite level* in the arms of the tube. Any difference in level as the clotting starts results in an anisotropy which gives consistently different elastic moduli when the gel is stressed in the two directions. Even when great care is taken with levelling, anisotropy sometimes makes its appearance. Should this happen, means of pairs of readings may be taken.

After filling the tube, a small drop of kerosene is immediately placed on the surface of the blood in each arm to prevent clotting in contact with air. Air bubbles are to be avoided as far as possible. In the large apparatus, the setting gel is loaded every few minutes at a series of increasing pressures in such a way as to produce about equal deformations. This is very difficult to do with the micro-apparatus. Moreover blood, unlike milk curd, shows a negligible elastic after-effect (Scott Blair and Burnett, 1959c), so that techniques involving some lag in the apparatus will not obscure any of the properties to be measured. In the micro-technique, pressure is increased at a steady rate (conveniently about 10-15 cm. water/sec.) until the recorder indicates a preselected displacement. At the moment when this is reached, the pressure is held stationary at the maximal value which it has attained and the differential pressure on the gel is reduced to zero. A few seconds later, the amount of elastic recovery (ε) is recorded and also the final pressure reading (P). Dividing the latter by the former gives a figure which has only to be multiplied by an apparatus constant to give the shear modulus of the gel in dynes/cm^2. (Scott Blair and Burnett, 1957.)

Copley (1941) and Copley, Krchma and Whitney,

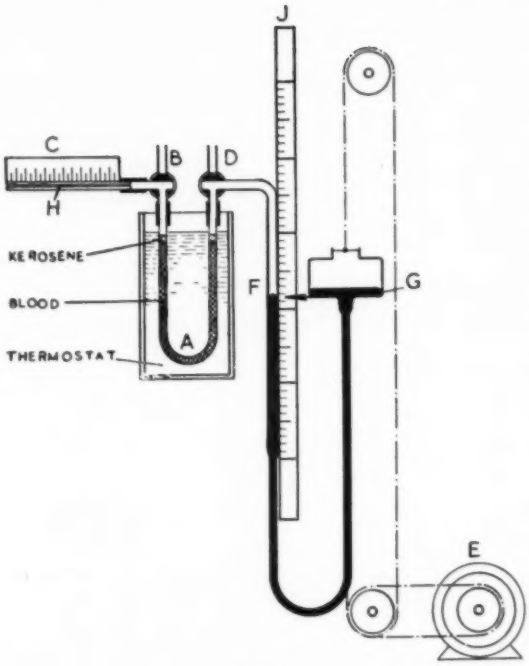

Fig. 1.

(1942) showed that blood is, under some circumstances, thixotropic. It seems that this is also true of blood clots as, if loadings are done very frequently, there is a tendency for the measured elastic modulus to increase more slowly, normal rate of increase being recovered if the sample is given a rest. For this reason, a fairly even spacing of the tests on a logarithmic time scale is desirable. To ensure this, it is convenient to plot the values of P/ε on semi-logarithmic graph sheet as they are obtained, increasing the times between the readings in such a way that the points fall at about equal intervals along the log time axis.

Details of the Apparatus

The apparatus is shown in Fig. 1 in diagrammatic form.

The U-tube A is clamped in a small thermostat bath held conveniently at 25°C., though 37°C. or any other suitable temperature may be used if desired. The tube contains 1 ml. of blood under the kerosene seals. One arm is attached, through the three-way cock B to the recorder C, while the other is connected to the three-way cock D. This cock is attached to a switch so that the geared motor E is running while the U-tube is connected to the mercury column F, but is off in other positions. When the motor is running, the mercury reservoir G is lifted or lowered at a steady rate, so that the difference in mercury levels between F and G change at the prescribed rate (in the present case, about 12 cm. water/sec.).

In the large gelometer, the recorder capillary is kept wide, to avoid lag due to the viscosity of the air. For the present purpose, this is not important and a capillary of 0·2 mm. bore is used. This gives a magnification of the mean displacements in the U-tube of 225-fold. It is, however, important that the recorder capillary be kept extremely clean and it is as well to mix into the coloured alcohol which forms the tiny 'index' (H), a small quantity of Teepol to reduce the surface tension as much as possible. The scale against which the index is read is reduced photographically from a centimetre scale by a factor of 3·0, so that each scale unit equals 3·33 mm. and corresponds to a displacement of about 15μ in the gel. The scale is read under a lens. Positive and negative pressures are applied alternately. Because of the compression or expansion of the air in the tube above F, the level of the mercury at F changes during the experiment. Before recording the pressure, the sliding scale J is adjusted so that the zero coincides with the meniscus at F.

This particular method for effecting a constant rate of increase of pressure was used because the apparatus needed for it can be cheaply and quickly made. Alternatively, a piston moving in a cylinder, or any other similar device, would be equally effective.

Some typical curves are shown in Fig. 2.

These samples had been stored at about 3°C. for times varying from about 30-45 min. The time zero was taken from the moment when the sample was placed in the thermostat at 25°. This procedure is not very satisfactory; it would be better to take the samples straight from the cow but this was not convenient. It seems likely that the rather large difference in the intercepts of the two curves from blood taken from cow A on different days is at least partly due to the uncertainty of the zero. Cow B consistently gave curves with smaller slopes such as that shown in the figure. This difference is probably characteristic of the animal and suggests further experiments.

The curves are plotted on a logarithmic time scale. In general, such curves are approximately linear and, as has been shown elsewhere, (Scott Blair and Burnett, 1958b) this implies that the rate of coagulation at any

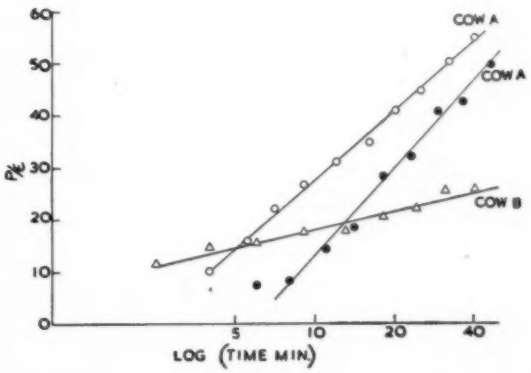

Fig. 2.

time is nearly proportional to the amount of as yet uncoagulated material. This is easily interpreted in the case of rennetted milk but the processes of coagulation of blood are much more complex.

With both materials, however, it seems likely that the slopes of the logarithmic setting curves and their extrapolated intercepts on the log time axis are independent variables and that the effect of some variant on the former can in no way be inferred from its effect on the latter, or on the 'coagulation time' which differs only slightly from it.

ACKNOWLEDGMENT.—*We are indebted to Dr. A. L. Copley for much encouragement and many helpful discussions.*

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Application of a Commercial Thermostat to Fine Temperature Control

by F. S. H. Abram

Salmon and Freshwater Fisheries Laboratory, Ministry of Agriculture, Fisheries and Food, London, S.W.1

A SIMPLE thermostatic unit having the advantages of robustness, ease of maintenance and low price has been developed for use over long periods in 40 litre water baths.

The device (Fig. 1) consists of an aquarium heater, and a thermostat housed in a watertight container, the whole being immersed below water level. The thermostat selected was the 'Otter' Type O Mark IV, which may be obtained covering ranges of 20°C. from 5° to 150°C., and with a differential of approximately 2·5°C. This coarse differential was reduced, as described below.

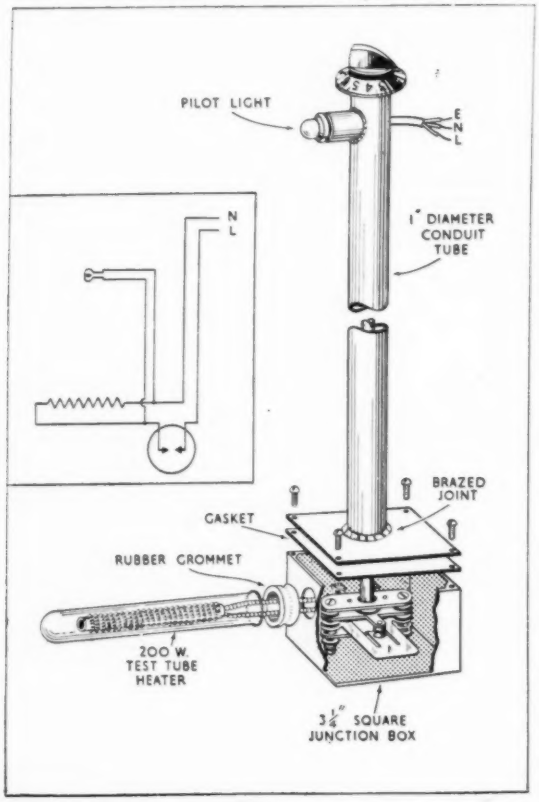

Fig. 1.

The unit was mounted inside a heavy electrical junction box, and an orthodox 200 watt aquarium heater, with the rubber sealing plug removed, was fitted as shown. A length of conduit tube fixed to the top of the box enabled the control spindle to be extended above water level, and carried a flex to the heater and thermostat. A neon pilot light was wired in parallel with the heater.

On turning the current on in a cold bath, sufficient heat escapes from the element into the air in the box to raise the temperature of the thermostat above that of the water. This difference in temperature slightly exceeds the differential setting of about 2·5°C. When the bath temperature comes to about 4°C. of the 'make' temperature of the thermostat, the unit 'breaks' the circuit, and the surrounding water cools the box until the 'make' re-occurs.

The thermostat then feeds the heater with successive pulses of current which decrease in duration and frequency until the bath temperature rises above the 'make' setting. Further heat pulses cannot occur until the bath cools to below the 'make' point.

Setting is carried out by immersing the unit for a few minutes in water of the desired temperature, and turning the control knob up until the 'make' point is located. The current does not necessarily need to be on, as the thermostat 'makes' with an audible click.

This unit has maintained the temperature of test aquaria at levels between 18·0° and 30·0°C., ± 0·1°C. for periods up to three months without attention. The unit has also been used to switch a 2 kilowatt heater, wired in parallel with the built-in heater. The total price of components (including pilot light, control knob, engraved escutcheon, thermostat and 200 watt heater) was £1. 14s. 7d.

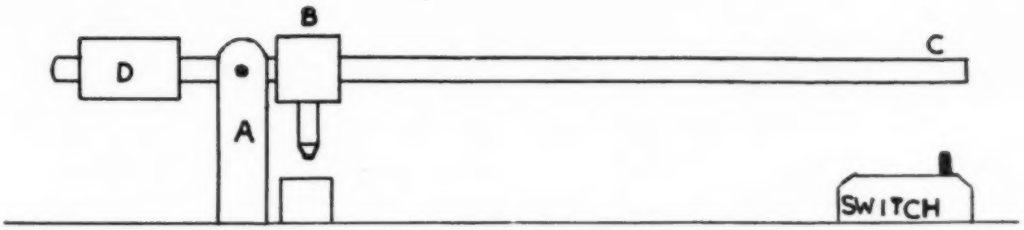

Fig. 1.

A Mechanical Hardness Tester for Cubed Materials

by A. W. Hartley, A.M.C.T., F.R.I.C.

Spillers Central Laboratory, Cambridge

THERE are many types of cubed or compressed products which have to be manufactured to a specified degree of hardness for a particular purpose. Examples are sugar cubes, pelleted pharmaceutical tablets and cubes and pellets for animal feeding.

In the case of cubes for cattle feeding their hardness is a matter of interest both to the animal food manufacturer and to the livestock feeder.

In our early experiments on the design of a cube hardness tester we made use of a spring balance (0-100 lb. range). The pan support was removed and replaced by a tooth-shaped piece of metal. The cattle cube was placed against this in a suitable holder, and pressure was exerted on the opposite side of the cube by a hand operated screw. The balance pointer rose steadily as the screw was wound up until the cube suddenly broke under the tooth, whereupon the pointer immediately returned to zero. This apparatus suffered from the disadvantages that hand operation made the increase of load jerky and uncertain, and constant observation of the pointer was necessary to avoid missing the breaking point. The present apparatus was designed to overcome these limitations, the basic principle of using a lever of the second order being that used by Powers (1958) for testing the crushing strength of sugar cubes.

An instrument of a similar type but greater sensitivity has been designed by Brooks and Hale (1955) to measure the strength of the shell of the hen's egg. In their instrument the system used for increasing the load is of a different type.

The instrument consists of a lever pivoted at A with the 'tooth' at point B on the long arm AC (Fig. 1).

A moveable weight is also placed at point B at the start of the test. The total weight of the arm AC is counterbalanced by the driving motor and an adjustable counter weight D. With a cube under the 'tooth' at B, the motor is started. This rotates a threaded rod which moves the weight B towards C at a constant speed thus increasing the weight on the 'tooth'. When the cube suddenly breaks, the lever descends rapidly and actuates a switch which stops the motor. The lever is graduated with a scale so that the position of the weight B which caused breakage can be noted. The split weight B is then lifted off the screw thread and returned to its zero position for the next test. Fig. 2 shows a general view of the instrument and Fig. 3 shows more clearly the construction of the weight mechanism .

Validity of Results on Cattle Cubes

When the instrument was used to test cattle cubes it was found that tests on a very small number of cubes yielded mean values which were not reproducible. In any sample a range of values is found due to non-homogeneity of the cube structure. A large number of experiments showed that if 50 cubes per sample are tested a reproducible mean value will normally be obtained. Tests with such a number enable distribution diagrams to be drawn, if necessary, and an assessment of the 'spread' about the mean can be made. A test on 50 cubes can be made in about 30 minutes.

Application of the Instrument

The hardness tester has been used to assess the effect of changes in ingredients, alteration in cubing conditions and the influence of moisture content on cube hardness.

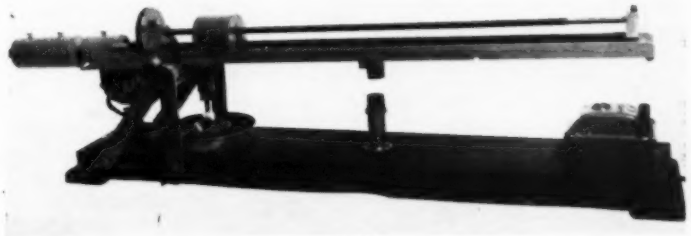

Fig. 2.

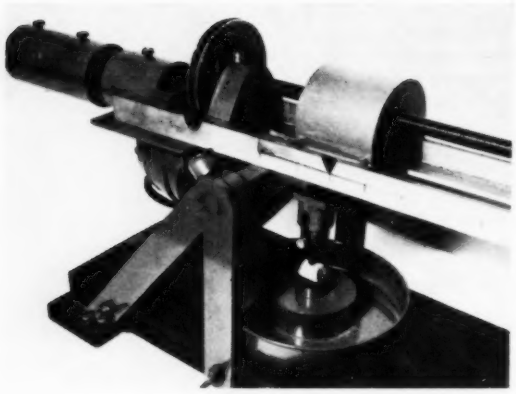

Fig. 3.

The moisture content is of particular importance because cubes which are entirely satisfactory when manufactured can become very much harder when stored under unsuitable conditions, due to a loss of only a few per cent moisture.

Although the instrument was designed specifically for cattle cubes, it can be applied to measurements on many other products. The sensitivity can be altered by changing the design of the plunger face and the size of the travelling weight. Possible applications are in the testing of sugar and confectionery products, biscuits, plastics and ceramics or any article which shatters or cracks under the steady application of an increasing load.

The instrument is manufactured by L. Bonnett, 208 Chesterton Road, Cambridge.

My thanks are due to the Directors of Spillers Limited for permission to publish this article and to the Chief Chemist, Dr. John Williams, F.R.I.C., for his interest in the development of this apparatus.

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Mechanical Engineering Research

The Council for Scientific and Industrial Research announces that in future the Mechanical Engineering Research Laboratory at East Kilbride, near Glasgow, will be known as the National Engineering Laboratory. This is because the Council considers it desirable to emphasize the national character of the Laboratory which is part of the D.S.I.R. organization and is financed from public funds. It does not imply any change in the field covered by the Laboratory, which will continue to be concerned with problems of mechanical engineering.

The Council has also decided to set up a Steering Committee to look after the programme of the Laboratory.

The object of the Laboratory is to establish the principles and extend the knowledge of mechanical engineering science so as to provide industry with the information it requires for the solution of its own particular problems. In order therefore that its work may be focused on practical objectives of real value to industry (which may involve basic or applied research or, in suitable cases, development work), the Council has decided that the planning of the Laboratory's activities and the selection of research projects can best be under the control of a small body with a measure of executive authority.

The new Steering Committee will be under the chairmanship of Vice Admiral Sir Frank Mason, K.C.B., M.I.Mech.E., M.I.Mar.E., who is a member of the Research Council and chairman of the outgoing Mechanical Engineering Research Board. The members of the Committee will be: Prof. O. A. Saunders, M.A., D.Sc., M.I.Mech.E., F.Inst.P., F.Inst.F., F.R.S., Professor of Mechanical Engineering at the Imperial College of Science and Technology, University of London; Norman Elce, Esq., M.Sc.Tech., M.I.Mech.E., Director and Chief Mechanical Engineer of Metropolitan-Vickers Electrical Co. Ltd.; Dr. D. G. Sopwith, C.B.E., D.Sc., M.I.Mech.E., Director of the Mechanical Engineering Research Laboratory; and Dr. C. M. Cawley, C.B.E., D.Sc., F.R.I.C., Director of Stations and Grants Division, D.S.I.R.

The Committee's terms of reference are:

1. To be responsible to the Research Council for the selection of projects and for the allocation of effort to them, within the financial resources allocated to the Laboratory and such other limits as may from time to time be imposed by the Council.

2. To report annually to Council, submitting a research programme for the following year.

The Committee, which will be a full committee of the Research Council, is empowered to set up specialist subcommittees to provide technical advice on particular fields of work.

In order to assist the Director as the Laboratory expands and to improve and extend the links between the Laboratory and industry, two Deputy Directors have been appointed. They are Dr. S. P. Hutton and Mr. F. D. Penny.

The Estimation of Physiologically Active, Naturally Occurring Substances in the Tissues and Body Fluids.

(*Concluded from page* 215)

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NOTE: Part VIII of this series of articles was published in the August 1958 issue of Laboratory Practice.

CORRECTIONS (Part VIII of this series):

Page 467, col. 2, paragraph 2, line 10: For 'Sensitivity is 0·01 to 0·1 μg./ml.' read '. . . 0·01 to 0·1 ng./ml.'

Page 467, col. 2, paragraph 4, lines 2, 11 and 12 should read 5ng./ml., and 0·5ng./ml. and 0·01ng./ml. respectively.

Page 468, col. 1, lines 1 and 2 should read 0·1 ng. and 1 ng./ml.

Page 468, col. 1, paragraph 2, lines 12 and 14 should read 0·01 to 0·1 ng./ml. and 0·0000001 ng./ml.

BOOK REVIEWS

The Design of Physics Research Laboratories. An Institute of Physics Symposium. London: Chapman & Hall. 1959. 21s. pp. 108.

This is an account of the proceedings of a symposium held in March 1958. Articles contributed dealt essentially with the following: Introduction (J. S. Forrest). The Architect and Physics (Basil Spence), Planning Research Laboratories (T. Emmerson), Recent American Design Trends (C. S. Haines), Services and Facilities (B. C. Fleming-Williams), Buildings, Services and Maintenance (J. C. Cornwell), Laboratory Design (R. G. Hopkinson).

It must be confessed that despite the fact that these reports make interesting reading, they are mainly too generalized to be of much practical use to your reviewer, for example, who happens to be involved in planning a new (small) research laboratory. Many of the comments made are largely platitudes and patently obvious. Contributions from industrial laboratories, showed complete failure to recognize the desperate cost limitations always imposed on University departments. The illustrated elaborate canteen and charming visitor's room are not the kind of luxury a university professor can plan for! And a bird's eye view of a vast U.S.A. car park is exciting but not very helpful.

It might almost be imagined that wealthy industrial laboratories are the only organizations concerned with research. The sections on supply services were more to the point and some especially practical valuable studies on light distribution are reported on in the last paper. A valuable additional practical contribution from D. A. Oliver is given in the 'Discussion'. This whole discussion gets down to real 'brass tacks', and in fact there are numerous valuable suggestions in this section coming, as they do, from those actively engaged in laboratory design and development.

On the whole, the report was worth producing, but is not likely to help the individual planner a great deal.

—S. TOLANSKY.

Extensive Air Showers, by W. Galbraith, Ph.D. London: Butterworths Scientific Publications. U.S.A.: Academic Press, Inc. U.K.: 40s. U.S.A.: $7.50. pp. 211 + xvi.

This book is restricted to the study of the more energetic component of incident cosmic radiation and its effects in producing extensive air showers. It is, then, concerned with one narrow field in cosmic ray physics, those showers found to extend often over several hundred metres and which may require an incident particle with the enormous energy of 10^{19}eV. Of necessity this book is largely devoted to meson physics as the showers are now considered to initiate as nucleon cascades and only later to develop into photon-electron cascades. There are eight chapters. The first deals with the theory of the shower process, the second with the lateral spread of the showers. The theory given is not overburdened with mathematics, indeed the summary of the (vast) experimental results plays a principal part of the context. The third chapter is devoted to penetrating particles and is again essentially a compact survey of experimental results. The density spectrum, i.e. the frequency distribution, is next treated, here necessarily rather more mathematics is needed, but it is used judiciously. Longitude and altitude effects, followed by underground observations and then searches for time variations, occupy considerable attention, again experimental.

Surprisingly enough the book has only one single cloud chamber photograph, which is perhaps evidence that nowadays counters are by far the most important research weapon in the armoury of the shower specialist. The last chapter is devoted to Cerenkov radiation. An adequate bibliography completes the book.

This is a useful book for the third year Honours student and for the postgraduate to dip into. For those who intend to specialize in cosmic rays, in meson physics, or the physics of the atmosphere, it is an invaluable condensation of a formidably vast literature and ought to be read by them. For others, with their overloaded timetables, it is still useful, especially for preparation of an essay. The style is easy and the production is excellent. It should certainly be in every University physics departmental library. The price is perhaps high for the student, when the specialized character is remembered but the amount of illustration justifies the cost.—S. TOLANSKY.

Photographic Chemistry, Vol. 1, by Pierre Glafkides, translated from the French by Keith M. Hornsby, F.R.P.S. London: Fountain Press. £5. 5s. pp. 491 + xiii.

This ambitious work translated from the French by Mr. Keith Hornsby has a foreword by no less a person than Mr. L. P. Clerc, F.R.P.S. who states that 'all the books in the French language on this subject are at least 30 years old, and therefore largely out of date'. The author of this book has therefore done no small service in rectifying this lapse on the part of the French photographic world.

Although all photographers of any enterprise will find much of value in reading this work, it is only fair to say that its greatest benefit will be to the photographic scientist and advanced student.

The book is divided into two parts. Part 1 'The formation and development of the photographic image', deals with this subject under 16 chapter headings.

In attempting to be perhaps too comprehensive the author includes the allied subject of physics. The nature of light, sensitometry, and latent image formation, and the early chapters are inclined to be so condensed that they make very difficult reading even for the experienced physicist, while to the average photographic reader they must be almost incomprehensible.

The chapters dealing with pH and redox potential and their part in the theory of development, and in fact all the chapters dealing with the development of the photographic image, and fixing washing and drying,

form the most valuable part of the book for the ordinary photographer.

It should be pointed out, however, that the author's statement 'that any substance with a redox potential below 0·120V can develop a photographic image' appears to be at variance with a passage from 'The Science of Photography' by Dr. Baines which states 'It was thought that a reducing agent would be a photographic developer if its redox potential fell within certain limits but this hypothesis had to be abandoned as there was no rigid correlation between developing action and redox potential'.

The chapters on developing solution, fine grain developers, and use of developing solutions contain a great deal of very useful information on the characteristics of the formulae given, together with notes on their modification, and I have no doubt that this part of the work will prove of great value to those who prefer making up their own solutions.

The subject of grain is dealt with very fully and is illustrated with some of the very few half-tone plates used in this work: although these show the point under discussion they would undoubtedly have been improved if they had been printed on art paper.

Sensitometric laws, sensitometry and photographic reproduction are very adequately dealt with in the chapters that close this part of the work.

Part 2, 'Photographic emulsions', is concerned with the properties of gelatin, general principles of emulsion preparations and base materials. Included in this part of the work are also chapters on UV photography, X-ray and charged particle photography, photosensitive systems and special techniques.

Gelatin, which as every photographer knows plays such an important part in photography, not only as a vehicle for the silver salts but also on the character of the emulsion, is dealt with at very great length in the first chapter of this part of the book; its chemical structure, the various methods of manufacture, and their effect on the silver emulsion are also covered.

The chapters that follow deal with the general principles of emulsion preparation, negative and bromide emulsion formulae and the stabilizing and finishing of photographic emulsions, and since it is unusual to find this subject included in this type of work, it makes very informative and interesting reading even to the layman.

There are over 900 references included in the bibliography which further enhances the value of this work. It is difficult to do anything like justice to a work such as this in a review of this nature, but it is hoped that some idea of its scope and impressiveness will have been given here.

The second volume promised deals chiefly with colour photography. It remains to say that I feel sure that this work will make no mean addition to the serious photographic worker's library.

—NORMAN GRUBER.

The Determination of Fatty Acid Composition by Gas Chromatography and U.V. Spectrophotometric Methods

by L. Malin, B.Sc., A.R.I.C.

IN the early days of the fatty acid industry, specifications, which were limited to a few chemical characteristics, were usually more than sufficient to satisfy the most discerning customer.

This situation has now been radically altered particularly in the post war years since an ever expanding chemical industry has not only evolved newer uses for fatty acids but has also become more and more particular when choosing its raw materials.

The techniques of gas chromatography and U.V. spectrophotometry have played no mean part in these trends. Employing these methods the chemist is not only able to obtain a precise check on the composition of a fatty acid mixture but, particularly in respect of gas chromatography, his analysis is effected simply and with a minimum of effort.

Gas Chromatography

The original classical work into the chemical structure of naturally occurring fats and oils was largely due to the efforts of T. P. Hilditch[1] and his co-workers. The method of fatty acid chain length analysis by ester fractionation employed by these workers involved considerable practical and analytical work as well as somewhat lengthy calculations. The advent of gas chromatography has almost completely replaced these classical methods since using this newer technique the complete composition of a fatty acid mixture in respect of chain length can now be performed on minute quantities of material within a matter of one to two hours. Furthermore, the instrument performs the analysis automatically leaving the chemist free for other duties.

The original research in this country in the field of gas chromatography was performed by James and Martin[2] who separated the fatty acids up to lauric acid on a column of silicone DC550/ stearic acid and estimated the fractions by an automatic titration procedure.

The most striking advance in this field was, however, made by Cropper and Heywood[3] who utilized catharometers working in conjunction with a high speed recorder for detecting the separated components of the mixture. They also developed column packings which withstood high temperatures and thus permitted the analysis of the methyl esters of the fatty acids of up to C.22 chain length.

It is not within the scope of this paper to describe in detail the instruments and procedure used in analysing fatty acid mixtures by gas chromatography. The reader interested in obtaining further details is referred to the various excellent text-books[4] on the subject, the Proceedings of the Symposium on V.P.C. sponsored by the Institute of Petroleum 1956[5] or alternatively to the various instrument manufacturers' literature[6]. It might also be mentioned in this con-

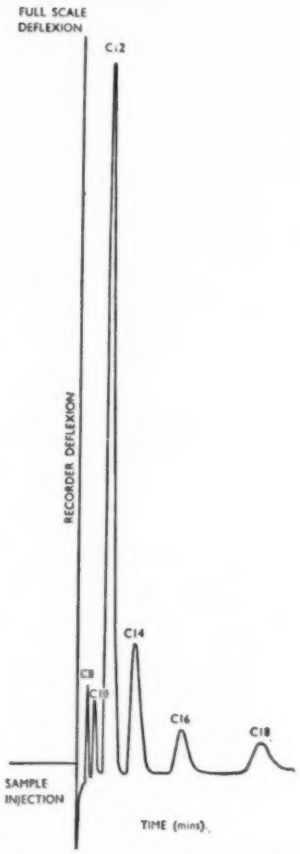

Fig. 1. (*Left*). **Methyl esters of distilled palm kernel fatty acids.**

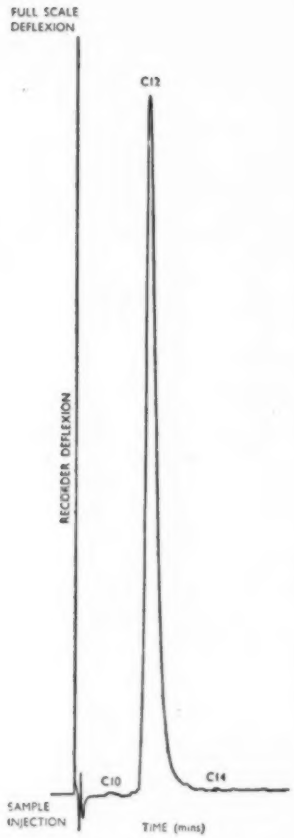

Fig. 2. (*Right*). **Methyl ester of 98 per cent pure lauric acid fraction.**

nection that Messrs. Podbielniak have compiled a very helpful bibliography of literature references on the subject of gas chromatography.

The method employed in our laboratory utilizes a Griffin & George Ltd. Mark 11a high temperature instrument. Other equipment can be used some of which employ different types of detectors. The column packings used are those developed by Cropper & Heywood, i.e. silicone grease supported on salt crystals, and for methyl esters of fatty acids of chain length C.8.-C.22 the usual corresponding column temperatures and vacuum conditions are approximately 150-250°C. (depending upon chain length) at an inlet pressure of 80 mm. Hg. and an outlet pressure of 120 mm. Hg.

To perform an analysis it is our practice first to prepare the corresponding methyl ester of the fatty acid mixture under test. One to two drops of this ester are then introduced into the packed column by means of a hypodermic syringe via a self sealing rubber cap.

The sample immediately vaporizes at the temperature of the column and is carried through the latter by a steady flow of nitrogen gas (designated the 'carrier gas'). Operating under these conditions extremely high separation efficiencies are achieved (some writers claim up to 2,000 equivalent theoretical plates per 4 ft. column) and the component methyl esters emerge from the column as completely separate fractions. These are continuously detected by a catharometer system which essentially consists of two spirals of platinum wire connected across the arms of a type of Wheatstone bridge circuit. The first spiral is situated in the ingoing stream of nitrogen prior to entering the column while the other spiral is situated in the stream of gas emerging from the column. Under these conditions the presence of fatty acid methyl esters in the emergent gas stream alters the conductivity of the outlet catharometer and puts the system out of balance, resulting in a deflection on the recorder. Thus as each component emerges from the column a peak is traced on the recorder chart. Typical complete traces are shown in Figs. 1 and 2.

For a particular set of conditions each component fatty acid ester has its own characteristic position in the trace thus permitting simple qualitative analysis. The percentage of each component is readily obtained since the area under each peak is directly proportional to the amount of the given ester present in the original mixture.

The analytical method described above is, in the field of fatty acids, used essentially for chemical assay in respect of chain length only, but a method has recently been suggested which is claimed[7] to enable resolution between saturated and unsaturated acids to be obtained. This type of analysis is, however, usually performed by the U.V. spectrophotometer.

U.V. Spectrophotometric Analyses

Analysis of unsaturated fatty acid mixtures by U.V. spectrophotometry depends upon the fact that conjugated fatty acids absorb ultra violet light at certain definite wavelengths.

It has also been discovered that conjugation can be induced by heating the non-conjugated acids at temperatures of the order of 180°C. in the presence of excess of an isomerization reagent, usually potassium hydroxide in either glycol or glycerol solution.

Several workers[8] have isolated pure acids from natural fats, submitted these to standard isomerization procedures and determined the resultant U.V. absorption. In this way methods have been evolved for the analysis of fatty acid mixtures containing linolec, linolenic, oleic and saturated acids.

It must be pointed out that there is no universally accepted procedure for performing these analyses although efforts are being made in the U.S.A. to standardize these methods.

It is the practice in our laboratory to use the following method: 0·1 g. of the fatty acid are heated at 180°C. in the presence of 11·0 g. KOH/glycerol reagent (17·6 g. pure KOH dissolved in 126 g. CP. glycerol at 200°C.), for a period of 30 min. using an oil bath controlled to $\pm$ 0·5°C. At the same time a blank test is performed.

The tests are then cooled, dissolved in absolute alcohol and suitably diluted, to give readings at 232mμ on a 268mμ on a U.V. spectrophotometer in a 1 cm. cell. At 232 mμ maximum absorption occurs as a result of conjugated diene acids and triene acids, whereas the absorption maxima which occurs at 268mμ is produced only by the conjugated triene acids.

Thus by measuring the amount of absorption at each wavelength produced by the original aliquot of fatty acid after isomerizing, the percentage of each unsaturated component acid can be calculated using the following standard equations.

Let W = weight of sample taken in the test.

Then assuming the isomerized fatty acid is diluted to 250 ml. the absorption readings (E) for this solution are:

E at 268 mμ = X

E at 232 mμ = Y

N.B. It is appreciated that for highly unsaturated fatty acids further dilution will be required in order to obtain a suitable instrument reading. This can be allowed for in the calculation since Beer's Law indicates that the light absorption of dilute solutions is proportional to the concentration.

Then linolenic acid per cent

$$= \frac{2{\cdot}5}{W} (0{\cdot}187X) = P \text{ per cent}$$

and linoleic acid per cent

$$= \frac{2{\cdot}5}{W} (0{\cdot}113Y - 0{\cdot}127X) = Q \text{ per cent}$$

Then if the iodine value of the original fatty acid mixture = I

Oleic acid per cent

$$= 1{\cdot}113 (I - 2{\cdot}735P - 1{\cdot}811Q) = R \text{ per cent}$$

then saturated acids plus unsaponifiable matter

$$= 100 - (P + Q + R) \text{ per cent}$$

A combination of gas chromatographic methods and the U.V. spectrophotometric procedures will, therefore, give a complete composition of a fatty acid mixture in terms of saturated and unsaturated components although it must be mentioned that some materials still present certain difficulties.

Application of these Methods to Industrial Problems

Primarily these techniques are important because they enable the chemist to perform analyses with a precision and rapidity which has hitherto been impossible. As a result the manufacturer is in a position to supply the exact type of fatty acid required by the consumer for his particular application.

The fractionation of palm kernel oil fatty acids for the production of high purity acids, e.g. lauric and myristic acids, can be laboratory controlled by actual fatty acid composition analysis on gas chromatography apparatus.

Similarly an alkyd grade semi-drying oil fatty acid can be assessed accurately for linolenic acid content in order to estimate its probable yellowing properties. In the same field the increase of conjugation during the manufacture of dehydrated caster oil can be measured.

Many more examples could be quoted but it is apparent that a wider field has been opened up to the fatty acid chemist by the introduction of these techniques.

At the Universal Oil Co. Ltd. these and other methods are being used for quality control of products. They are also available for development work on customer's problems.

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Foreign Members of the Royal Society

At a recent meeting of the Royal Society the following were elected Foreign Members of the Society:

Prof. Melvin Calvin.—The University of California, Berkeley, California, U.S.A. Distinguished for his researches into the mechanisms of photosynthesis.

Prof. Gerhard Domagk.—The University of Münster, and Director, Research Laboratories for Experimental Pathology and Bacteriology, Farbenfabriken Bayer, Wuppertal-Elberfeld, Germany. Distinguished for his researches leading to the discovery of Prontosil, the first chemotherapeutic agent against septic infection.

Prof. Jan Hendrick Oort.—The State University of Leiden, The Netherlands. Distinguished for his contributions to the knowledge of galactic structure, of stellar distribution and of stellar dynamics.

Prof. Axel Hugo Teodor Theorell.—The Nobel Medical Institute, Stockholm, Sweden. Distinguished for his work in the field of enzyme chemistry, particularly in relation to oxidation in animal tissues.

A view of the fume hooded area. In the centre foreground are the centralized titration facilities.

OPENING OF MODERN FOOD CONTROL LABORATORY

THE new control laboratory which was opened by Prof. T. P. Hilditch, C.B.E., D.Sc.(LOND.), F.R.I.C., F.R.S., at the Stork Margarine Works, Bromborough, ranks among the largest and best equipped of its type in the world. It also represents the first completed stage of a £3½ million five-year reconstruction plan now under way at the Van den Berghs and Jurgens factory.

The extensive laboratory facilities were formerly sited at two locations within the factory, but this arrangement, in addition to being inconvenient, was incapable of further expansion to meet future needs. The provision of a new centralized works laboratory was, therefore, top priority in the reconstruction plan.

Covering approximately 8,000 sq. ft., the new control laboratory is divided into 15 laboratories and offices, accommodating the staff of 36, four of whom are graduates, under the direction of the chief chemist, Mr. W. L. Wren, B.Sc.(LOND.), F.R.I.C. The design and layout is highly flexible and can readily accommodate the more elaborate instrumental techniques which are developing.

The bacteriological section is concerned with dairy control, maintenance of high standards of plant cleaning and the regular examination of products at all stages of manufacture to ensure compliance with the high quality standards regarded as normal by the company.

Chemical control has the same objective and covers analysis of raw and intermediate materials and final products.

The laboratory or, more correctly, group of laboratories, is located on the first floor of the new L-shaped block of buildings.

The short 'leg' of the 'L' accommodates the main raw materials and finished products laboratory, the investigations laboratory, and the balance room. In the long 'leg' are the bacteriological and other smaller laboratories, covering vitamin assay and physical testing, etc., a store room and office/library, etc.

An interesting facility shared by the raw materials and finished products laboratory and the adjacent investigations

A general view of the bacteriological laboratory.

The bacteriological laboratory showing the incubators.

laboratory is the vented bench space. A bench unit common to the two laboratories, but divided by a glass window, has been provided with two actual fume cupboards in the outside wall. This arrangement considerably simplifies the ventilation problem.

Raw Materials and Finished Products Laboratory

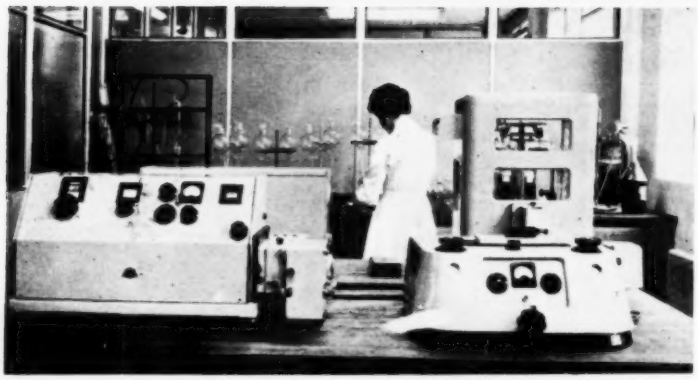
Occupying some 2,000 sq. ft., this laboratory is equipped with Iroko wood topped benches designed to meet the company's requirements regarding cupboard and drawer arrangements, number and positioning of gas and water taps, sinks and reagent bottle shelving. The oak benches extend from the window wall, an arrangement which is both functional and attractive in appearance.

A special feature of the main laboratory is the provision of a fume hooded bench area, which covers just over a third of the inside wall. This consists of a three-sided unit which houses, together with the fume hooded bench adjacent to the investigations laboratory, all apparatus generating steam or hot air.

This centralization of heated or heating equipment in a vented area, in addition to being operationally convenient, ensures that working conditions in the laboratory are controlled only by the central heating system and not by the work being undertaken at any given moment.

Other notable features are the provision of the constant temperature rooms covering a wide temperature range (0°-50°C.), and controlled humidity. Titration facilities are centrally arranged on a bench designed for this operation.

A general view of the main raw materials and finished products laboratory.



The vitamin A assay laboratory. UV and visible spectrophotometers are seen in the foreground.

Balance Room

This room is immediately adjacent to the main laboratory and is conveniently situated between the investigations and bacteriological laboratories.

The balance benches consist of tiled brick pillars surmounted by vibration pads and the tops are slate slabs. The floor is also specially designed to minimize vibration.

Bacteriological Laboratory

Although smaller than the main chemical laboratory, the bacteriological laboratory occupies just over 1,000 sq. ft. and is provided with a bench which extends virtually the full length of one of its longer walls. Several central, moveable tables are also provided for the work more conveniently conducted at table height than at bench level. These tables are Formica topped—this type of surface is easier to clean.

This laboratory has two special features—a high temperature room for accelerated storage work and a tiled drained floor area over which is fitted a vented hood, for installation of the autoclaves. This ensures that steam is not released into an open laboratory.

Investigations Laboratory

Situated adjacent to the chemical/physical laboratory, the investigations laboratory is equipped with benching of a similar type to that in the main laboratory. Special equipment, including a gas liquid chromatographic apparatus, is accommodated in this room.

Although, of course, pure research is not conducted in this factory control laboratory, there remains a considerable amount of non-routine work handled by more senior and graduate staff. The investigations laboratory is intended to expedite this type of activity.

Rooms in the laboratory block with features of particular interest include the vitamin A assay laboratory with its island bench for the UV spectrophotometers—a feature designed to facilitate easy operation, and maintenance of these instruments.

The design of the apparatus washing room—centrally located for all departments—was evolved after full consideration by engineers, production study staff and laboratory management. The room has two double drainer sink units, floor level sinks and four forced draft apparatus drying cupboards.

Laboratory and office work in these new laboratories have been separated, as it was considered advantageous to provide properly equipped and furnished offices instead of glassed-in offices in the various laboratories. A feature of all the offices is the use of sound-proofing material.

The chief chemist and his secretary occupy adjacent rooms in the main raw materials and finished products laboratory; the section managers in charge of chemical and bacteriological control share an office in the long 'leg' of the 'L', which is also the departmental reference library. Linked telephones in the laboratories and offices enable the section managers to be contacted in their laboratories or their offices.

Laboratory Suppliers

Suppliers of apparatus and equipment are: Aimer Products; Astell Laboratories; Baird & Tatlock; Electrothermal; W. Edwards; Gallenkamp; Glen Creston; Hanovia; Hellewell; Hospital & Laboratories Supplies; Hawkesley & Son; Johnson Matthey; Lock; Liverpool Workshops for the Blind; M.S.E.; Permutit; Pye; Remington Rand; Sargent; Swift; Stanton; Sartorius; Sunvic; Towers; Townson & Mercer; Thermal Syndicate; U.G.B.; Watson; X-Lon Products; Zeal; Zeiss.

Suppliers of reagents and chemicals are: B.D.H.; British Oxygen; F. W. Berk; B.I.S.; Burroughs Wellcome; Evans Medical Supplies; Hopkin & Williams; I.C.I.; Ilford; Light; May & Baker; Oxo; Shell; Whiffen.

Royal Society Research Appointments

The Council of the Royal Society has made the following appointments in original scientific research:

Royal Society Research Fellowships (Mr. and Mrs. John Jaffé Donation) have been awarded to:

(a) Dr. G. Hoyle, D.Sc. (Glasgow), of the Department of Zoology, University of Glasgow, to work on excitation/contraction coupling in muscle and nervous mechanism in behaviour of insects from October 1, 1959 at the Department of Zoology and Institute of Physiology, University of Glasgow.

(b) Dr. J. Owen, M.A., D.Phil. (Oxon.), of the Clarendon Laboratory, Oxford, to work on exchange interactions in magnetic systems from October 1, 1959 at the Clarendon Laboratory, Oxford.

Royal Society Research Studentships (Mr. and Mrs. John Jaffé Donation) have been awarded to:

(a) Mr. K. L. Manchester, M.A. (Cantab.), of the Department of Biochemistry, University of Cambridge, to work on the mechanism of the regulation by hormones of protein synthesis from October 1, 1959 at the Department of Biochemistry, University of Cambridge.

(b) Dr. M. L. Whelan, M.A., Ph.D. (Cantab.), of the Crystallographic Laboratory, Cavendish Laboratory, Cambridge, to carry out investigations of metals by transmission electron microscopy from October 1, 1959 at the Department of Physics, Cavendish Laboratory, Cambridge.

John Murray Travelling Studentships in Oceanography and Limnology for 1959 have been awarded to:

(a) Mr. A. D. Ansell, B.Sc. (Reading), of the Marine Station, Millport, Isle of Cumbrae, to work on problems of the laboratory rearing of bivalve larvae at the U.S. Fish and Wildlife Laboratory, Milford, U.S.A.

(b) Mr. G. Evans, B.Sc. (Bristol), of Imperial College, University of London, to work on marine sediments at sea but based on the Scripps Institute of Oceanography, La Jolla, California, U.S.A.

Recent British Standards

Analysis of Iron and Steel

This new publication (B.S. 1121, Part 39:1959, price 4s.) specifies a method for the determination of nitrogen in all types of steel containing up to 0·25 per cent nitrogen. (Complete nitrogen recovery, the Standard points out, cannot be obtained from steels containing silicon and nitride.)

B.S. 1121: Part 39—which forms part of a programme of standardizing methods for the determination of elements in iron and steel—will be of particular value as a referee method.

Copies of this Standard may be obtained from the British Standards Institution, Sales Branch, 2 Park Street, London, W.1.

Laboratory Note-Book

A virological laboratory is to be established in Edinburgh shortly by the South-Eastern Regional Hospital board, at the City Hospital, at an estimated cost of £28,000. Financial help has been made available for the building and for equipment by the Wellcome Trust.

An offer from the Wellcome Trust amounting to that sum has been accepted. The cost of building is estimated at £22,000 and the equipment at £6,000. The Scottish Hospital Endowments Research Trust is being approached for an annual grant of £6,000 to meet the cost of staff requirements.

'This is really one of the most important medical steps which the Board has taken so far in research into virus complaints, and we welcome it', said a spokesman of Edinburgh Corporation Health Department. 'At the moment there is only a small laboratory available at the university medical department for experimental purposes'.

Oestrogens in Livestock Fattening

The Agricultural Research Council has been enquiring into the possible dangers (whether to man or animals) associated with the practice of administering synthetic oestrogens for the fattening of livestock (including poultry). This investigation is not yet quite complete, but certain points are already clear and a brief statement on these aspects will be of value.

Stilboestrol and hexoestrol, the substances used to promote fattening of livestock whether by implantation in the animal or by inclusion in feedingstuffs, are potent drugs which act primarily on the reproductive organs. There is no apparent risk of damage to the animals when the drugs are used on beasts intended for slaughter, in the dosages recommended by the manufacturers. When animals change hands it is always possible, however, that they may be treated more than once, and overdosing might lead to some undesirable side-effects and possibly render the meat less attractive, although not dangerous to the consumer. But since oestrogens will in certain circumstances cause sterility, the use of these substances on animals not intended for slaughter is to be avoided. Above all, farmers should ensure in their own interest not only that breeding stock are not implanted with stilboestrol or hexoestrol, but also that in no circumstances are feedingstuffs containing these hormones fed to them.

These substances can have a serious toxic effect on man when small amounts are swallowed or even inhaled and attention is drawn to the dangers of home mixing of these materials with other feedingstuffs on the farm. Great care should be taken with all oestrogen-containing substances. They should be kept in a safe place and, in particular, well away from children.

The Council's enquiry includes investigations into the behaviour of synthetic oestrogens excreted by animals. The results of experiments so far obtained indicate that the risk of the contamination of pastures and soil by accumulation is not serious but until the results have been confirmed, the Council cannot positively assert that there is no risk.

R.I.C.'s New President

Ernest Le Quesne Herbert, B.Sc., F.H.W.C., M.Inst.F., F.Inst.Pet., M.I.Chem.E., F.R.I.C., took office on April 17, 1959, as President of the Royal Institute of Chemistry for the ensuing two years.

He was born in Newcastle-upon-Tyne in 1902, and was educated at the Royal Grammar School there. He afterwards studied chemistry at the Heriot-Watt College, of which he has recently been elected an Honorary Fellow, and at the University of Edinburgh, where he graduated in 1922.

Mr. Herbert has made his career in the petroleum and petroleum chemicals industries. He first joined the Anglo-Iranian Oil Co. Ltd. at Llandarcy as a chemist and remained there until 1926. He joined the Shell Group in 1937, and spent the next 12 years in Mexico. After a year at the Shell Haven Refinery, he went to the refining company's Head Office in London early in 1939. Throughout the war he was in charge of the team responsible for co-ordinating all operations at Shell's refineries in the United Kingdom, including the part played by Shell in the construction and operation of the Government-owned gas-oil hydrogenation plant and aviation fuel refinery at Heysham.

Since the war he has directed the Shell Group's manufacturing expansion (both petroleum and chemicals) in the United Kingdom, which has included the development of major plants at Stanlow and Shell Haven. During this period he was appointed successively Assistant General Manager, General Manager, and, in 1955, Managing Director of Shell Refining Co. Ltd. He is also a Director of Shell Chemical Co. Ltd., Trimpell Ltd., and Associated Ethyl Co. Ltd.

Mr. Herbert has had wide experience of the organization and operation of scientific societies, professional institutions, and industrial and government committees. He is a Vice-President of the Institute of Petroleum and has been nominated for election this year as a Vice-President of the Institution of Chemical Engineers. He is also a Member of the Institute of Fuel. From 1946 to 1950 he was honorary secretary of the Chemical Engineering Group of the Society of Chemical Industry, and from 1954 to 1958 he served as a Member of Council of the Association of British Chemical Manufacturers; from 1954 also he has served on the Ministry of Transport and Civil Aviation Committee on the Prevention of Pollution of the Sea by Oil.

Mr. Herbert was elected a Member of Council of the Royal Institute of Chemistry in 1957, when he had been a corporate member for 30 years. During these last two years he has taken an active part in the work of the Institute's Finance and House, Benevolent Fund, and Educational Trust Fund Committees He has a special interest not only in the application of chemical science to industry, but also in the education and training of young people, and the encouragement of those with suitable qualities to take up chemistry as a career.

Research Flights

Scientists of the Radio Research Station D.S.I.R. are flying with the Meteorological Research Flight of the Air Ministry to obtain new data affecting radio wave propagation. They are measuring and recording changes in the refractive index of the lower atmosphere at heights up to at least 10,000 ft. using a microwave refractometer specially built at Slough for this work.

The refractive index is a measure of the property of the air which produces bending of radio waves. Under certain meteorological conditions the strength of an ultra-high frequency signal at a receiving station beyond the horizon is considerably influenced by the atmospheric structure and the variation of the refractive index. Earlier methods of measurement have produced only limited information on this feature of the lower atmosphere—and it is hoped that this airborne technique will fill in the gaps in existing knowledge.

The first stage in this research began at Slough about a year ago, when scientists started construction of a suitable microwave refractometer which could be installed into a Hastings aircraft. Equipment proving flights followed, during which the apparatus was tested under varying conditions. Now the scientists look forward to going ahead with the actual measurement work.

The apparatus records the refractive index changes on a photographic-type recorder. The sensitivity of the instrument can be varied to measure either the large fluctuations extending over a considerable height or the smaller variations which occur, for example, in or near clouds. Compared with conventional methods, this instrument can record rapid fluctuations, but a new model now being made at Slough will have an even smaller response time.

This technique was first developed by scientific workers in the United States and it is hoped that its application here will lead our scientists to a better understanding of certain features of wave propagation.

News from the British Association of Chemists

News from the Sections

London

The Annual Section Meeting was held on Wednesday, May 6, 1959, at which Officers for 1959/60 were elected as follows:

Chairman: Mr. V. J. Potter.
Vice-Chairman: Mr. T. Bewley.
Hon. Treasurer: Mr. H. Morris.
Secretaries: Mr. E. H. G. Sargent, Dr. C. W. Capp.
Section Councillors:
Area No. 1. Mr. J. A. Newell, Mr. V. J. Potter.
Area No. 2. Mr. E. H. G. Sargent, Mr. W. A. Phillips.
Committee: Dr. A. T. Healey, Mr. P. A. Farmer, Mr. G. Robertson, Mr. G. A. Segar, Miss M. F. Locke.

After the business of the meeting had been concluded, those present took supper together. This was followed by an address given by the retiring Chairman, Mr. E. H. G. Sargent, A.C.G.F.C., F.Inst.P. who is the Chief Research Chemist with Astor Boisselier & Lawrence Ltd. by whose kind permission the address was given.

The subject of the address was 'Fancy Wrapping Materials' and Mr. Sargent said that the earliest known example appeared to be the gold foil wrapping used as far back as 1500 B.C. by the Egyptians. About the middle of the last century a tin-lead alloy, popularly known as 'silver paper', appeared. A further development was the use of aluminium foil and since the end of World War II metal foils have become one of the four most important classes of film-like packaging materials. Although this material itself is a very useful packaging medium, for complete protection it is frequently desirable to use a composite material with some other film such as paper, regenerated cellulose, Polythene or, more recently, Saran. These laminants are usually made by coating the aluminium with a suitable adhesive and then rolling the backing material on to the prepared surface.

Coated papers were next considered. One of these is vegetable parchment. This is a very high gloss material which is readily printed and is extremely resistant to vegetable oils. Paraffin wax coated paper was first developed about 90 years ago and thousands of tons of it are still used. Its appearance was not particularly attractive and considerable efforts have been made recently to produce a wax coating that is both attractive and useful. Other types of petroleum waxes, known as microcrystalline waxes, produce desirable coatings of good gloss which are resistant to creasing and scruffing. Various substances, many of a resinous nature, have been used as additives but only Polythene has achieved any considerable success in this field.

As well as wax coatings, lacquers and varnishes have been used and that which has found greatest favour up to date is probably nitro-cellulose. This gives a tough film on paper which is very glossy, water resistant and readily lends itself to heat sealing.

Regenerated cellulose was first produced about 1910 but was not very much used until about 1930. It has become very popular since the introduction of the moistureproof variety of this film, and sales in the U.S.A. reached the considerable figure of 63,000,000 dollars.

The fourth and most important class of film wrapping materials are plastic films, and the rapid increase in their share of the market coincided with the arrival of polyethylene. Polyethylene film is quite readily made provided the very expensive equipment necessary can be procured. There is a new arrival in this field, namely Polypropylene. This is even stronger and tougher than Polythene and is reported to be so tough that sharp metallic articles can be wrapped in it.

The full text of Mr. Sargent's address will be produced later in *The British Chemist*.

Yorkshire

The Annual Meeting of the Section was held at the George Hotel, Huddersfield, on Saturday, April 25, 1959.

Among the Officers elected for 1959/60 were the following:

Chairman: Mr. G. H. Whitehead.
Hon. Secretary: Mr. B. Wilkinson.
Hon. Treasurer: Mr. H. Cooper.

The General Secretary of the B.A.C. had been invited to attend and he reported progress in the Association generally as well as answering specific questions asked by members who were present.

Personalia

James Lawrie (B.A.C. Member) has been re-elected a Manager of the Royal Institution, London.

He has also been re-elected a Vice-President, under the Presidency of Lord Brabazon of Tara.

James Lawrie has for some years been Chairman of the Library Committee of the Royal Institution, which has recently re-organized its 70,000 volume library.

OBITUARY

Dr. J. Vargas Eyre—
Past President of the B.A.C.

It is with great regret that we announce the death of John Vargas Eyre, M.A., Ph.D., F.C.G.I., F.R.I.C., who was President of the B.A.C. from 1936 to 1939. He also took an active part in the work of Council and Committees for a number of years.

Dr. Eyre represented the City and Guilds of London Institute on the governing bodies of Ewell Technical College, Reigate Technical College, and three schools of art including Epsom and Ewell and Sutton and Cheam.

He studied Science at Leipzig University where he gained his M.A. and Ph.D., and from 1911 to 1919 he toured Europe extensively for the Ministry of Agriculture doing research into the development of flax and wrote numerous works on the subject.

While a Professor at Wye College between 1914 and 1919 he met his future wife, Kathleen.

As Director of Research for the Linen Institute, Dr. Eyre founded one of their Irish branches outside Belfast in 1920 and in the same year was made an F.R.I.C. Then in 1926 he became Director of the Research Department of the Distillers Company and in that capacity toured Europe and the U.S.A. He played a prominent part in the foundation of the company's plant at Great Burgh near Epsom.

During the Second World War he was in the Intelligence Department of the Home Guard and did duty on Epsom Downs. After retiring at the end of the war he was a consultant to the Coal Board.

During his retirement, Dr. Eyre devoted his energies mainly to education. He engineered the founding of the City and Guilds award for Technology, the Insignia Award.

Last year there was published his biography of the distinguished Scientist, Henry Edward Armstrong. His principal hobby was old glass and china upon which he was an authority.

All correspondence and enquiries concerning this Association should be addressed to G. R. Langdale, Esq., The British Association of Chemists, Nomination Dept., 14 Harley Street, London, W.1. Tel.: Museum 7021.

LABORATORY EQUIPMENT & APPLIANCES

B.T.L. 'Stabilec' Oven

The B.T.L. 'Stabilec' oven has recently been redesigned to bring it into line with modern requirements, and now provides a small, inexpensive oven suitable for many laboratory purposes.

The corrosion resistant chamber, 12 in. × 12 in. × 14 in. high, is available in either electro-tinned mild steel or stainless steel. It is insulated from the outer metal case by a 2 in. thickness of slag wool and is fitted with two removable shelves, one of which forms the working floor of the chamber. The two heaters, which operate at black heat, are of the electric fire type for easy replacement, and are readily accessible on removing the floor of the chamber. The insulated door seals on to the front of the chamber by means of an asbestos gasket. A bent-stemmed thermometer is recessed in the door, the bulb of the thermometer being protected by a metal guard. Control of the chamber temperature is effected by a standard B.T.L. bimetallic regulator fitted in a vertical position at the back of the chamber. The operation of the regulator is indicated by a pilot light. Accurate temperature setting over the range 30° to 200°C. can be achieved by means of a control knob situated at the front of the oven and marked with an arbitrary scale of 0-100, used in conjunction with the separate calibration table supplied with each oven.

The oven relies upon normal convection heating, and a non-adjustable air vent is fitted to the top of the chamber. The overall size of the oven is 17 in. wide × 17½ in. deep × 24 in. high; the weight is approximately 32 lb.; and the exterior is finished in grey stoved enamel. The oven is fitted with a 6 ft. lead with open ends and can be supplied for operation on either 100/125 V. or 200/250 V. with a maximum loading of 600 watts.

(Manufacturers: Baird & Tatlock (London) Ltd., Chadwell Heath, Essex.)

The B.T.L. 'Stabilec' oven.

U.V. Recorder

This is a miniature recorder which eliminates the need for the development of the record. The use of a high pressure mercury vapour lamp and special recording paper enables the record to be visible a few seconds after it is made.

The recorder measures only 107 × 147 × 289 mm. (4·2 × 5·8 × 11·3 in. and weighs less than 10 lb. It is in one complete self contained unit requiring only an external power supply of 50 volts D.C.

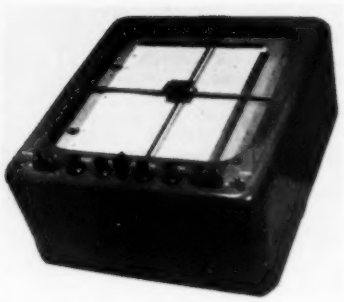
Up to six continuously varying and two discontinuous parameters may be recorded against an accurate one second time base. Twenty feet of 60 mm. wide paper can be accommodated in the recorder itself. If a longer duration is required, there is an external clip-on cassette which can contain a complete 100 ft. roll of recorder paper.

At present there are three types of recorder from which to choose, differing only in the speed of the paper.

(Manufacturers: SFIM (Great Britain) Ltd., 218-221 Bedford Avenue, Slough, Bucks.)

Houston HR-92 X-Y Recorder

The HR-92 X-Y recorder is a null-balance servo-type plotter designed to draw curves in Cartesian coordinates with an accuracy of better than 0·75 per cent. The flat-bed bench mounting construction utilizes 8½ in. × 11 in. graph paper with full chart visibility. The clip-on pen is of 'straight-through' design, with no bent capillaries, to facilitate cleaning, filling and rapid interchange for multicolour traces. The X and Y axes are electrically and mechanically independent; each employs a chopper-type amplifier with separate power supply, a two-phase servomotor and a 3-turn rebalance potentiometer energized by a mercury reference cell. The response is critically damped, with a pen speed of 7·5 in. per second and sensitivity of 10 millivolts per inch (alternatively 1mV/inch). The input resistance is 10,000 ohms but can be adjusted by removing an internal link to give infinite impedance at balance. The simplified control panel has duplicate zero setting and continuously variable attenuator adjustments, separate standby and power switches, and a 'load-operate' control which removes the pen carriage to facilitate rapid chart loading. Gain and calibration adjustments can be made by screw-driver controls readily accessible beneath the front panel. The plug-in unit construction of the amplifiers makes removal easy if servicing ever becomes necessary.



The HR-92 X-Y recorder.

The overall dimenions of the recorder are 14 in. × 15½ in. × 8 in. and the weight is 35 lb. Typical applications are the rapid plotting of transistor and valve characteristics, hysteresis or filter curves, computer readout, torque/speed, temperature/pressure, stress/strain, and other low frequency phenomena including bio-medical data.

A feature of this instrument is the moderate cost and the short delivery period.

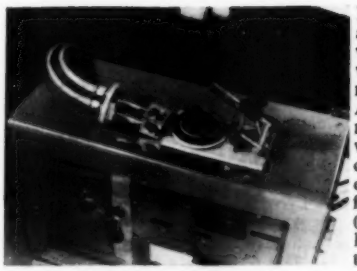
(Manufacturers: Houston Instrument Corporation, Texas, distributed in G.B. by Scientific Furnishings Ltd., Poynton, Cheshire.)

The Sigrist Photometer

Sigrist photometers manufactured in Switzerland are now available in the United Kingdom.

Sigrist photometers are designed for industrial and laboratory use, and all types employ a design feature which enables continuous measurements of turbidity and colour to be carried out quite independent of the usual sources of error found in conventional photometers, i.e. variations in photocell sensitivity, light source intensity and amplifier gain.

One type of Sigrist industrial photometer uses flow cells for turbidity and/or colour measurements having a wide variety of finishes for corrosive liquids and gases. Other types enable turbidity measurements to be made from the



The Sigrist photometer.

surface of a liquid and colour measurements from a free flowing jet.

Weatherproof cases make operation possible under the most arduous conditions.

The laboratory type makes turbidity and colour measurements possible from static measuring vessels and due to its independence on instrumental variations, many samples may be continuously compared with a standard over long periods, without adjustments.

The laboratory photometer may be fitted with a built in monochromator and recorder if desired.

(Suppliers in G.B.: Southern Instruments Ltd., Frimley Road, Camberley, Surrey.)

The Microcorder

The Microcorder extends the Micrometrical line of surface finish measuring instruments to include the measuring and recording of the roughness profile of a surface.

The Microcorder is portable and can be moved from place to place within the production department or laboratory and set-up in any convenient location near to the parts which are to be measured.

It is particularly important for studying surfaces which are pitted, porous, have flaws, scratches or other irregularities.

(Manufacturers: Micrometrical Manufacturing Co., 345 South Main Street, Ann Arbor, Michigan, U.S.A.).

γ-Ray Proportional Counter

The type PX.115 is a high resolution proportional counter originally developed for the γ-ray spectrometer. The energy resolution of a proportional counter below 100 Kev is better than that of a scintillation counter and its employment extends the range of scintillation γ-ray spectrometers to 20 Kev. γ-ray spectrometers are widely employed in the analysis of spectra such as that from fission products and the high resolution of the proportional counter is particularly useful in interpreting the complex spectra at low energies.

The counter is 2½ in. in diameter with an overall length of 16 in. It has a gas filling of a mixture of highly purified Xenon-Methane at a pressure of 2 atmospheres absolute and the operating voltage range is between 3,500 and 4,200 volts. Measurements of the energy resolution have been made using an Americium^{241} source which emits γ-rays of 59·4 Kev. The best resolution which has so far been obtained with these counters is 5·6 per cent. Over the operating range, the gas multiplication factor is 60 volts/db.

(Manufacturers: 20th Century Electronics Ltd., King Henry's Drive, New Addington, Croydon, Surrey.)

A D.C. Signal Source

This unit is a portable item of equipment and provides a D.C. signal of variable magnitude. It is invaluable in a laboratory where an accurate low powered D.C. supply is required for such purposes as testing of amplifiers, transistors, transductors, relay operating current measurements, and a great number of other applications.

The unit gives a 0-50V. D.C. supply which may be used either as a voltage source or a current source.

When used as a voltage source the 0-50V. D.C. supply is metered with a high grade 0-50 micro-amp meter used as a voltmeter and the metered output is then fed to an attenuator giving eight ranges of voltage on the range switch.

When used as a current source the 0-50V. D.C. supply is fed to the output terminals via the meter and the range switch shunts the meter and introduces a suitable limiting resistance in the output to prevent damage to the meter on each of the eight current ranges.

The unit is fitted with a reversing switch so that the polarity of the output may be reversed without having to disconnect the leads to the unit.

The unit is housed in an attractively styled case with a carrying handle, and may be operated from 190-250V. 50 cycles mains supply and consumes about 15 watts.

(Manufacturers: Bryans Aeroquipment Ltd., 1 Willow Lane, Mitcham Junction, Surrey.)

CATALOGUES, BROCHURES & LEAFLETS

Received from Manufacturers

Michrome Stains.—Edward Gurr Ltd. of 42 Upper Richmond Road West, London, S.W.14, have published a new price list for their michrome stains for microscopy, biological and histochemical reagents, etc.

B.D.H. Leaflets.—New entries in the catalogue of British Drug Houses Ltd., of Poole, Dorset, are listed in the March 1959 issue of their monthly leaflet. These are as follows: *Organic and Inorganic Chemicals.*—Carboxy-methylcellulose sodium salt and *p*-dimethylamino-benzaldehyde. The company have also issued a leaflet describing the determination of dissolved oxygen in boiler feed water by the indigo-carmine method by means of the B.D.H. Lovibond Nessleriser.

Heat-Treatment Journal.—The March 1959 issue (Vol. VII, No. 50) of the Wild-Barfield Heat-Treatment Journal published by Wild-Barfield Electric Furnaces Ltd. of Elecfurn Works, Otterspool Way, Watford-by-Pass, Watford, Herts., contains articles on modern heat-treatment equipment, furnaces for the motor industry and a selection of abstracts and references.

Laboratory News.—No. 2 (Third Series) of Towers Laboratory News has now been published by J. W. Towers & Co. Ltd. of Victoria House, Widnes, Lancs. Included in the contents are articles on aperiodic balances, variable voltage transformers, electric furnaces, open neck reaction vessels, vacuum pipeline systems hand-operated counter-current apparatus, the Alnor dew point meter, thermometer readers and viscometers and viscometers holders.

Reagents and Solvents.—Two recent publications issued by Hopkin & Williams Ltd., Freshwater Road, Chadwell Heath, Essex, deal with Spectrosol solvents for absorption spectroscopy and P.V.S. reagents purified for volumetric standardization.

Marconi Instrumentation.—Two of the articles contained in Marconi Instrumentation (Vol. 7, No. 1) published by Marconi Instruments Ltd. of St. Albans, Herts., deal with intermodulation testing using the Marconi white noise test set type OA 1249A and the uses of travelling wave tube amplifiers with reference to M.I. units types TF 1278 and TF 1278/1.

Electronic and Nucleonic Instruments.—To enable users of their electronic instruments catalogue to find the instrument in which they are interested, with a minimum of trouble and delay, future issues of the catalogue published by Ericsson Telephones Ltd., High Church Street, New Basford, Nottingham, will be divided into a number of sections under generic headings, with the leaflets assembled in ascending numerical order within each section.

B.D.H. Leaflets.—New entries in the catalogue of British Drug Houses Ltd., of Poole, Dorset, are listed in the April 1959 issue of their monthly leaflet. These are as follows: *Organic and Inorganic Chemicals.*—Carbon, granular; lithium borohydride. *Solutions for Analytical Use.*—Sodium hypochlorite low in bromine. *Indicators for Non-aqueous Titrations.*—Quinaldine red solution.

NEWS

Manufacturers' News

Expansion at B.T.L.

The Research and Development Division of Baird & Tatlock (London) Ltd. has recently been doubled in size to keep pace with the increasing demand both for 'Analmatic' equipment for automation in analysis and for new and redesigned standard laboratory instruments and apparatus.

To deal with these two aspects of the work of the Division two main sections have been formed

Research and Development ('Analmatic' Instruments).

Research and Development (General Instruments).

The Division, consisting of these two sections, will continue to operate under the direction of Sir Bernard Keen, D.Sc., F.Inst.P., F.R.S.

Griffin & George Group at Lisbon

Griffin & George (Sales) Limited, the selling organization of the Griffin & George Group of laboratory furnishers, exhibited at Lisbon Trade Fair a representative range of laboratory apparatus and equipment suitable for both industry and education and bearing especially on the Second Six Year Development Plan on which Portugal is about to embark. The exhibit also displayed examples of the range of metal unit laboratory furniture, marketed by the associate company, Griffin & George (Laboratory Construction) Limited and manufactured by Grundy Equipment Limited.

Extension to Mullard Research Laboratories

Two new laboratory blocks are being built on a site adjacent to the existing buildings of Mullard Research Laboratories at Salfords, nr. Redhill, Surrey.

An extra 45,000 sq. ft. of floor space will be provided by the new buildings, which will consist of a three and a four storey block. This will house the electronics, telecommunications, transistor applications and television laboratories which have been built up during recent years, parts of which have hitherto been operating in temporary buildings. It will also improve the facilities for the valve, semiconductor and materials research activities.

The laboratories at Salfords, with a total staff of nearly 700, are the central research unit of the Mullard Company.

Oxide Refractories

An exhibition of 'Purox'—oxide refractories was presented at the Mayfairia Rooms, Bryanston Street, London, W.1 from May 5 to 7.

A recent development at Morgan Refractories Ltd., Neston, Wirral, Cheshire—a subsidiary of The Morgan Crucible Company—has resulted in laboratory ware in these highly refractory materials becoming available to a greater degree of purity and in a wider range of shapes and sizes than has been possible in the past.

Superior quality oxide refractories are required in research and in industry for two main reasons—refractoriness and chemical compatibiltiy. These two requirements are synonymous with purity which is the first consideration in the manufacture of 'Purox' ware.

The range at present includes alumina, thoria, magnesia, and lime stabilized zirconia.

'*Purox*' *Recrystallised Alumina.*—Contains 99·7 per cent Al_2O_3. The crystal structure is the result of heat work alone, there being no addition to induce or reduce crystal growth. The material can be supplied as tubes, sheaths, crucibles, bricks, tiles, die pressings and special shapes. Tubes up to 7 in. bore, 4 ft. long, crucibles up to 8,000 cc. and tiles up to 15 in. × 5 in. × 2½ in. can be supplied to order.

'*Purox*' *Thoria.*—The analysis of the raw material used for the manufacture of this ware is 99·9 per cent. ThO_2. This grade can be supplied in standard and impervious forms to the same analysis.

Crucibles up to 250 cc. can be supplied to order. Tubes and sheaths can also be produced, in rather restricted sizes at the moment. For example, sheaths 500 mm. × 12 mm. × 8 mm. and also 660 mm. × 38 mm. × 32 mm. have been supplied.

'*Purox*' *Magnesia.*—This material is available in the form of crucibles, tubes, bricks, tiles, and small die pressings. 100 cc. crucibles are standard, and tubes and sheaths up to 800 mm. × 25 mm. × 20 mm. bore, and 458 mm. × 75 bore can be supplied to order. The analysis of 'Purox' magnesia varies with the method of manufacture.

'*Purox*' *Zirconia.*—This grade is fully stabilized and contains 97 per cent ZrO_2. Crucibles up to 50 cc. are standard, and tubes and sheaths up to 800 mm. × 25 mm. × 20 mm. and 525 mm. × 8 mm. × 5 mm. can be supplied to order.

'*Purox*' *Sintered Pure Alumina.*—This is made from the same material as 'Purox' recrystallized alumina, but it is fired to a lower temperature and is, therefore, not impervious. The size range is as wide as that of 'Purox' recrystallized alumina.

Dimensional Tolerances.—'Purox' ware is often required to very accurate dimensions, and grinding facilities are available to meet such requests.

Plus or minus 0·001 in. can be achieved readily, and both outside diameter up to 8 in., up to 3 ft. long, and bores of up to 6 in., up to 1 ft. long, can be ground.

W. German Agents Appointed

Mr. H. K. Voss, Technical Director of Voss Instruments Ltd., Maldon, Essex, has just returned from a visit to their Continental Agents. During his visit he appointed Mr. Wolfgang Zeh, Duisburg-Meiderich, Salmstrasse 12 as sole agent for Western Germany for their laboratory and Industrial Stirrers.

Personal Notes

American Visit

Mr. J. E. C. Bailey, C.B.E., Chairman and Managing Director of Baird & Tatlock (London) Ltd. and Hopkin and Williams Ltd., is visiting Canada and the U.S.A.

While in America, Mr. Bailey will address the Scientific Apparatus Makers of America at their Annual Conference at White Sulphur Springs, West Virginia. He will speak on the European Common Market, and how it will affect exports from non-member nations, including the United States.

Mr. Victor Lambert

Mr. Victor Lambert has been appointed to assist Mr. Norman Sheldon in the marketing of the Royal Worcester and Sillax laboratory porcelain made by The Worcester Royal Porcelain Co. Ltd., of Worcester and Monax and Perth brand laboratory glassware and other technical glassware made by John Moncrieff Ltd., of Perth.

Mr. Sheldon has been responsible for the marketing of the products of both firms since 1925 and the appointment of Mr. Lambert has been made in order to ensure that the joint sales organization can continue when Mr. Sheldon retires in a few years' time.

Mr. Sheldon has been chairman of the British Chemical Ware Manufacturer's Association since 1940 and has been very active in promoting the interests of the laboratory equipment industry.

Mr. N. J. Butler

As from March 1959, Mr. N. J. Butler, M.Sc. (N.Z.), M.I.Biol., became a partner in the consulting practice of Galloway & Barton-Wright, Industrial Microbiologists and Biochemists.

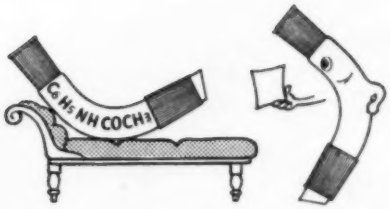
Publications

Glass Volumetric Apparatus

Testing of Glass Volumetric Apparatus, National Bureau of Standards Circular 602, by J. C. Hughes, 14 pages, issued April 1, 1959, supersedes Circular 434. (Available from the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C. price 20 cents.)

In order to encourage high quality in the manufacture and accuracy in the use of precision glass apparatus for measuring volume, the National Bureau of Standards has formulated the specifications contained in this publication.

Analysing organic compounds?



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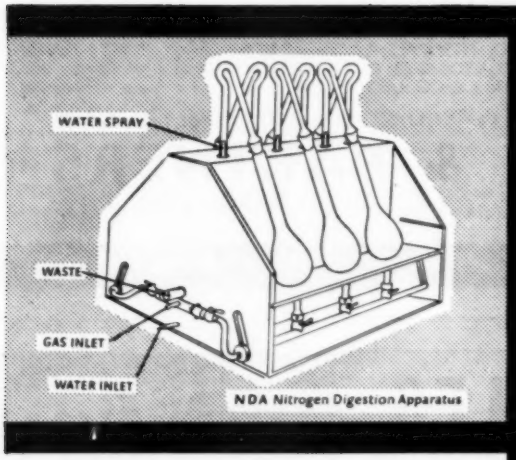

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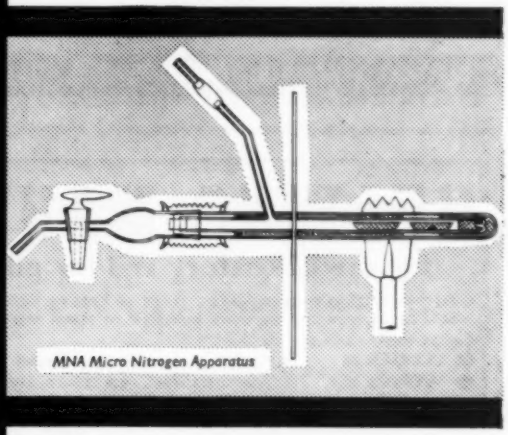

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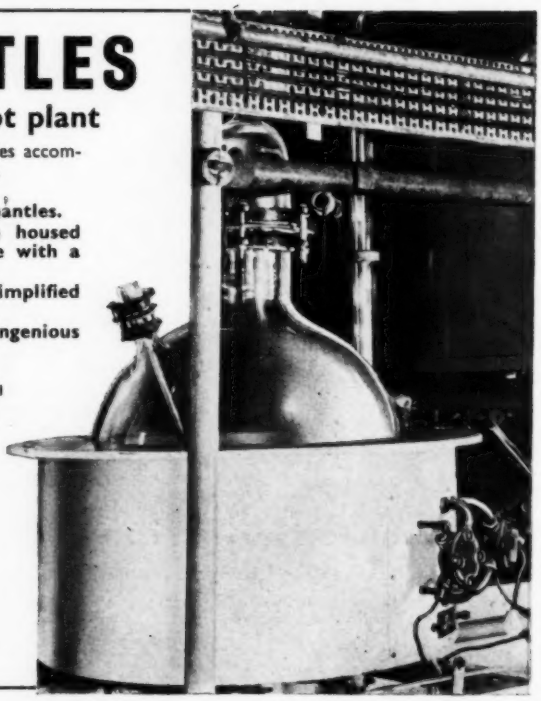

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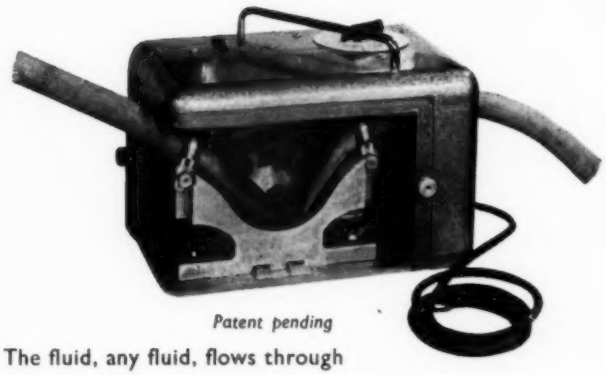

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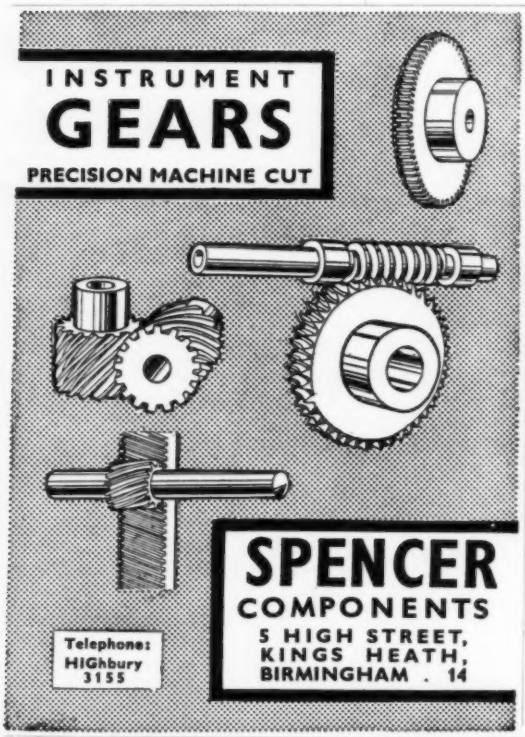

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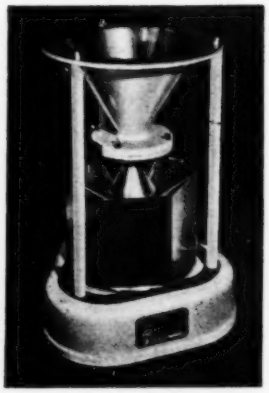

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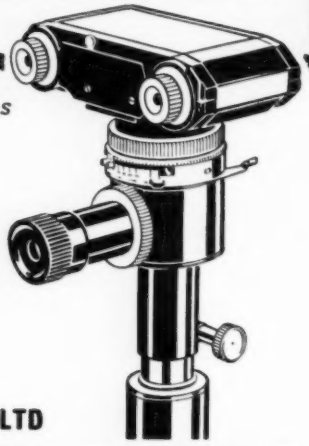

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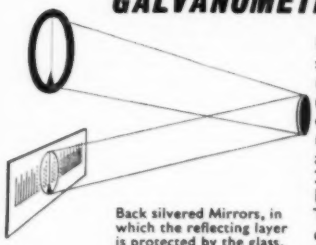

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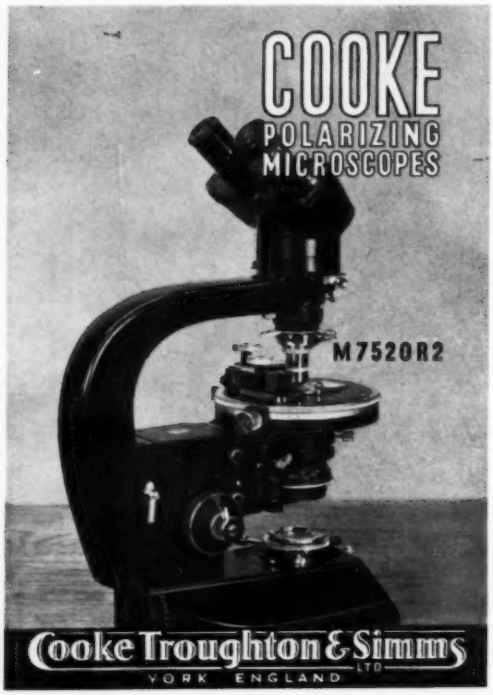

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continued on page cxl

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